



NATIONAL DEFENSE RESEARCH INSTITUTE

CHILDREN AND FAMILIES
EDUCATION AND THE ARTS
ENERGY AND ENVIRONMENT
HEALTH AND HEALTH CARE
INFRASTRUCTURE AND
TRANSPORTATION
INTERNATIONAL AFFAIRS
LAW AND BUSINESS
NATIONAL SECURITY
POPULATION AND AGING
PUBLIC SAFETY
SCIENCE AND TECHNOLOGY
TERRORISM AND
HOMELAND SECURITY

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis.

This electronic document was made available from www.rand.org as a public service of the RAND Corporation.

Skip all front matter: [Jump to Page 1](#) ▼

Support RAND

[Browse Reports & Bookstore](#)

[Make a charitable contribution](#)

For More Information

Visit RAND at www.rand.org

Explore the [RAND National Defense Research Institute](#)

View [document details](#)

Limited Electronic Distribution Rights

This document and trademark(s) contained herein are protected by law as indicated in a notice appearing later in this work. This electronic representation of RAND intellectual property is provided for non-commercial use only. Unauthorized posting of RAND electronic documents to a non-RAND website is prohibited. RAND electronic documents are protected under copyright law. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see [RAND Permissions](#).

Report Documentation Page				Form Approved OMB No. 0704-0188	
Public reporting burden for the collection of information is estimated to average 1 hour per response, including the time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington Headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington VA 22202-4302. Respondents should be aware that notwithstanding any other provision of law, no person shall be subject to a penalty for failing to comply with a collection of information if it does not display a currently valid OMB control number.					
1. REPORT DATE 2013		2. REPORT TYPE		3. DATES COVERED 00-00-2013 to 00-00-2013	
4. TITLE AND SUBTITLE Post-Traumatic Stress Disorder and the Earnings of Military Reservists				5a. CONTRACT NUMBER	
				5b. GRANT NUMBER	
				5c. PROGRAM ELEMENT NUMBER	
6. AUTHOR(S)				5d. PROJECT NUMBER	
				5e. TASK NUMBER	
				5f. WORK UNIT NUMBER	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) RAND Corporation,National Defense Research Institute,1776 Main Street, PO Box 2138,Santa Monica,CA,90407-2138				8. PERFORMING ORGANIZATION REPORT NUMBER	
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)				10. SPONSOR/MONITOR'S ACRONYM(S)	
				11. SPONSOR/MONITOR'S REPORT NUMBER(S)	
12. DISTRIBUTION/AVAILABILITY STATEMENT Approved for public release; distribution unlimited					
13. SUPPLEMENTARY NOTES					
14. ABSTRACT					
15. SUBJECT TERMS					
16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT Same as Report (SAR)	18. NUMBER OF PAGES 63	19a. NAME OF RESPONSIBLE PERSON
a. REPORT unclassified	b. ABSTRACT unclassified	c. THIS PAGE unclassified			

This product is part of the RAND Corporation technical report series. Reports may include research findings on a specific topic that is limited in scope; present discussions of the methodology employed in research; provide literature reviews, survey instruments, modeling exercises, guidelines for practitioners and research professionals, and supporting documentation; or deliver preliminary findings. All RAND reports undergo rigorous peer review to ensure that they meet high standards for research quality and objectivity.

TECHNICAL REPORT

Post-Traumatic Stress Disorder and the Earnings of Military Reservists

David S. Loughran, Paul Heaton

Prepared for the Office of the Secretary of Defense

Approved for public release; distribution unlimited



NATIONAL DEFENSE RESEARCH INSTITUTE

The research described in this report was prepared for the Office of the Secretary of Defense (OSD). The research was conducted within the RAND National Defense Research Institute, a federally funded research and development center sponsored by OSD, the Joint Staff, the Unified Combatant Commands, the Navy, the Marine Corps, the defense agencies, and the defense Intelligence Community under Contract W74V8H-06-C-0002.

The RAND Corporation is a nonprofit institution that helps improve policy and decisionmaking through research and analysis. RAND's publications do not necessarily reflect the opinions of its research clients and sponsors.

Support RAND—make a tax-deductible charitable contribution at www.rand.org/giving/contribute.html

RAND® is a registered trademark.

© Copyright 2013 RAND Corporation

This document and trademark(s) contained herein are protected by law. This representation of RAND intellectual property is provided for noncommercial use only. Unauthorized posting of RAND documents to a non-RAND website is prohibited. RAND documents are protected under copyright law. Permission is given to duplicate this document for personal use only, as long as it is unaltered and complete. Permission is required from RAND to reproduce, or reuse in another form, any of our research documents for commercial use. For information on reprint and linking permissions, please see the RAND permissions page (www.rand.org/pubs/permissions.html).

RAND OFFICES

SANTA MONICA, CA • WASHINGTON, DC
PITTSBURGH, PA • NEW ORLEANS, LA • JACKSON, MS • BOSTON, MA
DOHA, QA • CAMBRIDGE, UK • BRUSSELS, BE

www.rand.org

Preface

A substantial fraction of the active- and reserve-component members of the U.S. military deployed in support of Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) have returned home experiencing symptoms of post-traumatic stress disorder (PTSD). This report presents estimates of the correlation between the experience of PTSD symptoms and subsequent labor market earnings of military reservists and assesses the degree to which this correlation reflects the causal effect of PTSD symptoms versus the confounding effect of unobservable characteristics associated with PTSD symptoms and labor market outcomes. The report will be of interest to policymakers, manpower analysts, and mental health professionals concerned about the effects of deployment on the civilian lives of reservists and their families.

This research was sponsored by the Office of the Assistant Secretary of Defense for Reserve Affairs and conducted within the Forces and Resources Policy Center of the RAND National Defense Research Institute, a federally funded research and development center sponsored by the Office of the Secretary of Defense, the Joint Staff, the Unified Combatant Commands, the Navy, the Marine Corps, the defense agencies, and the defense Intelligence Community.

Comments regarding this study are welcome and may be addressed to David Loughran by email at david_loughran@rand.org. For more information on the RAND Forces and Resources Policy Center, see <http://www.rand.org/nsrd/ndri/centers/frp.html> or contact the director (contact information is provided on the web page).

Contents

Preface	iii
Figure and Tables	vii
Summary	ix
Acknowledgments	xiii
Abbreviations	xv
 CHAPTER ONE	
Introduction	1
 CHAPTER TWO	
Estimating the Relationship Between PTSD and Earnings	5
 CHAPTER THREE	
Data Sources	11
 CHAPTER FOUR	
How Do Reservists Symptomatic of PTSD Compare with the Overall Sample Population? ...	15
 CHAPTER FIVE	
The Effects of Being Symptomatic of PTSD on Earnings in the Year Following Deployment	19
Cross-Sectional Estimates	19
First-Differenced Estimates	22
Instrumental-Variable Estimates	23
Additional Robustness Checks	24
 CHAPTER SIX	
Longer-Run Effects on Earnings of Being Symptomatic of PTSD	27
 CHAPTER SEVEN	
Conclusions	31
 APPENDIXES	
A. Post-Deployment Health Assessment	33
B. Pre-Deployment Health Assessment	39
 Bibliography	 43

Figure and Tables

Figure

4.1. Trends in Pre-Deployment Earnings, by Eventual PTSD Symptoms and Deployment Location	18
---	----

Tables

4.1. Summary Statistics	16
5.1. OLS Estimates of the Relationship Between Post-Deployment Earnings and Being Symptomatic of PTSD	20
5.2. First-Differenced Estimates of the Effect on Earnings of Being Symptomatic of PTSD	22
5.3. IV Estimates of the Effect on Earnings of Being Symptomatic of PTSD.....	24
5.4. Additional Specifications.....	25
6.1. Effects of Being Symptomatic of PTSD on Earnings in Later Years	28
6.2. Effects of Being Symptomatic of PTSD on Measures of Military Persistence.....	30

Summary

The Department of Defense (DoD) has relied heavily on members of the reserve components of the U.S. military (hereafter referred to as *reservists*) to fight the wars in Iraq and Afghanistan. Reservists have suffered a variety of injuries during their deployments, many of which could significantly impact their future well-being. Among those injuries is the condition known as post-traumatic stress disorder (PTSD), an anxiety disorder that is precipitated by the experience of a traumatic event. Recent evidence suggests a high prevalence of PTSD among returning active- and reserve-component service members (e.g., Tanielian and Jaycox, 2008), prompting significant interest in the long-term consequences of PTSD for a variety of health, family, and economic outcomes.

This report investigates the effects of being symptomatic of PTSD on the employment and earnings of reservists in the years following deployment. Only a handful of studies directly estimate the effect of PTSD on the labor market outcomes of veterans, and none include U.S. veterans of the wars in Iraq and Afghanistan. Moreover, although the existing studies control for some covariates that are related to both labor market outcomes and PTSD, most lack data on such critical factors as ability and other dimensions of health. Thus, it remains unclear whether the associations they document represent causal effects of PTSD on labor market outcomes or the confounding effect of omitted factors. This report demonstrates that, while reservists symptomatic of PTSD do in fact earn substantially less than those who are not symptomatic of PTSD, much of that gap was apparent prior to deployment and the onset of PTSD symptoms. This fact suggests that characteristics of reservists correlated with reporting symptoms of PTSD are responsible for much of the observed difference in earnings between reservists who ultimately report PTSD symptoms at the end of deployment and those who do not.

Data and Methods

In this study, we combine administrative data on PTSD symptoms among more than 315,000 reservists returning from deployments between 2003 and 2006 with longitudinal labor market earnings data to estimate the effects on earnings of being symptomatic of PTSD. Our data on PTSD symptoms are drawn from the Post-Deployment Health Assessment (PDHA), a health screening questionnaire that has been mandatory for virtually all service members returning from deployment since April 2003. Although we do not have access to formal diagnostic information regarding PTSD, the questionnaire includes the Primary Care PTSD (PC-PTSD) screening instrument. Researchers have demonstrated that responses to this instrument, which asks whether respondents have experienced any of four symptoms of PTSD, are highly correlated with clinical diagnoses of PTSD. We link relevant information from military personnel

and pay files and annual earnings data obtained from the Social Security Administration to the PDHA sample to estimate a variety of earnings and employment models.

Ordinary least squares (OLS) models take advantage of the availability of measures in data on such factors as pre-deployment health and aptitude that are correlated with experiencing PTSD symptoms and labor market outcomes, while fixed-effect models allow us to control fully for time-invariant unobservable factors. We also estimate instrumental-variable (IV) regressions that isolate exogenous variation in PTSD symptoms attributable to deployment location.

Although our data are particularly well suited to studying the effect of being symptomatic of PTSD on labor market outcomes, we nevertheless acknowledge several potential limitations of our empirical approach. First, as was done in most previous studies of PTSD, we observe whether individuals in our sample are symptomatic of PTSD rather than formally diagnosed with PTSD. Thus, we interpret our estimates as the effect of being symptomatic of PTSD rather than of being diagnosed with PTSD. It is possible that being diagnosed with PTSD has larger effects on labor market outcomes than being merely symptomatic. Second, reservists in our data reported whether they experienced specific symptoms of PTSD near the end of the deployment period. Consequently, we do not know whether they experienced these symptoms at the time their earnings were measured one or more years later. All else being equal, this type of misclassification could cause us to underestimate the effect of contemporaneous PTSD symptoms on labor market outcomes. Third, as in other mental health research contexts, separating the effects of PTSD symptoms from other illnesses comorbid with PTSD symptoms, such as depression, remains a formidable challenge. In some models, we control directly for indicators of other psychological problems, but to the extent that PTSD causes these problems, including such controls may lead us to underestimate the true effect of being symptomatic of PTSD. However, failure to control for such comorbid conditions could cause us to overestimate the effect of being symptomatic of PTSD. Finally, we have no information on post-deployment mental health treatment received by individuals in our sample, so our estimates combine effects for reservists who do and do not receive treatment for PTSD. If treatment ameliorates some of the negative effects of PTSD symptoms, our estimates will be attenuated relative to the effects that would be expected in the absence of treatment.

Results

We report first that reservists symptomatic of PTSD at the end of their deployment are disadvantaged across numerous domains, including factors determined prior to deployment. Reservists symptomatic of PTSD earn substantially less than average in both their military and civilian employment prior to deployment. These reservists also exhibit lower educational attainment and scores on the Armed Forces Qualification Test (AFQT). The average annual pre-deployment earnings of reservists symptomatic of PTSD are \$6,027 less than those of reservists not symptomatic of PTSD, a difference of 17 percent. Reservists symptomatic of PTSD also tend to reside in areas with slightly lower income and higher shares of single-parent families and are drawn disproportionately from the Army and from lower ranks. Prior to deployment, reservists who are ultimately symptomatic of PTSD report worse-than-average general health and are considerably more likely to have sought recent treatment for a mental health issue than reservists not symptomatic of PTSD. Following deployment, reservists symp-

tomatic of PTSD also exhibit a relatively high incidence of other health problems, particularly symptoms associated with depression. This evidence strongly suggests that the propensity to experience PTSD symptoms at the end of deployment is correlated with individual characteristics that are established prior to the experience of the trauma that leads to PTSD.

In the year following deployment, reservists symptomatic of PTSD earn 17 percent less than reservists who are not symptomatic of PTSD—the same gap that existed pre-deployment. However, this gap diminishes to 5 percent once we account for demographic differences between the two groups. The estimated gap in earnings in the first year following deployment diminishes even further when we estimate first-differenced and IV models, which are likely to provide superior controls for endogeneity and unobserved heterogeneity. First-differenced models imply that being symptomatic of PTSD lowers the earnings of reservists in the first year following deployment by about 1 to 2 percent, while IV models imply effects of about 4 percent. We find larger effects of being symptomatic of PTSD on underemployment, suggesting that the impact of PTSD symptoms might be more substantial for those in the lower tails of the earnings distribution.

Although some reservists doubtless experience substantial problems in the labor market stemming from combat-related psychological trauma, our analysis indicates that the average short-run effects of being symptomatic of PTSD are small. Over time, however, the effect on earnings of being symptomatic of PTSD appears to increase in our first-differenced model, growing to about 6 percent of total earnings by the fourth year following deployment. These longer-term negative effects on earnings are attributable entirely to higher military separation rates among those symptomatic of PTSD, a concomitant decline in military earnings, and no compensating increase in civilian labor market earnings.

Implications

Our empirical results have several implications. First, while it is clear that reservists who are symptomatic of PTSD earn less than those who are not, it would appear that a large portion of the correlation is attributable to fixed characteristics of individuals correlated with reporting symptoms of PTSD rather than to the effect of being symptomatic of PTSD per se. Our data demonstrate that symptoms of PTSD occur nonrandomly, underscoring the necessity of carefully isolating the effects of mental health problems from other factors that may contribute to adverse labor market and other outcomes.

Second, while PTSD symptoms appear to have little effect on civilian earnings, they have large effects on longer-run military earnings. Reservists symptomatic of PTSD at the end of deployment leave the military at much higher rates than other deployed reservists, but why this happens is unclear. It is possible that individuals begin with similar tastes for military service but that traumatic experiences while deployed engender negative perceptions of military service in general and perhaps fear of being deployed in the future. This seems like a particularly relevant possibility given that continuing to serve in the military might exacerbate PTSD symptoms for some individuals by exposing them to circumstances that remind them of prior traumatic events. Alternatively, it is possible that being symptomatic of PTSD makes reservists less productive in their military careers or carries a stigma that compromises their ability to advance. Given the large number of veterans exposed to traumatic events in Iraq and Afghanistan, further research to better understand how PTSD and the factors that make individuals susceptible to it affect military careers is warranted.

Acknowledgments

We would like to thank Jim Hosek, Sue Hosek, Rajeev Ramchand, Chris Rohlf, Terry Schell, Terri Tanielian; our project sponsors within the Office of the Assistant Secretary of Defense for Reserve Affairs; and seminar participants at the RAND Corporation; University of Nevada, Las Vegas; and the Western Economic Association annual meetings for helpful suggestions. We are especially indebted to our RAND colleagues Grant Marshall and Carole Gresenz for their careful reviews of this report. Craig Martin of RAND provided outstanding programming assistance, and Michael Risha of the Social Security Administration was instrumental in obtaining the earnings data employed in this research and executing our analysis programs.

Abbreviations

AFQT	Armed Forces Qualification Test
DoD	Department of Defense
DSM-IV	<i>Diagnostic and Statistical Manual of Mental Disorders</i> , 4th Edition
FICA	Federal Insurance Contributions Act
IV	instrumental variable
IV-FD	instrumental variables first-differenced
OEF	Operation Enduring Freedom
OIF	Operation Iraqi Freedom
OLS	ordinary least squares
OLS-FD	ordinary least squares first-differenced
PC-PTSD	Primary Care PTSD
PCL	PTSD Checklist
PDHA	Post-Deployment Health Assessment (DD Form 2796)
PTSD	post-traumatic stress disorder
SSA	Social Security Administration

Introduction

Between 2001 and 2007, roughly 1.2 million members of the active component of the U.S. military and 455,000 members of the National Guard and Reserve were deployed to Iraq and Afghanistan and exposed to the physical and mental stress of daily life in a combat zone in support of Operation Enduring Freedom and Operation Iraqi Freedom (OEF/OIF) (CRS, 2008). Several recent studies indicate that a substantial fraction of service members returning from Iraq and Afghanistan suffer lasting psychological injury (Hoge, Auchterlonie, and Milliken, 2006; Hoge et al., 2004). Although psychological injury can take many forms, concern among policymakers and the public has largely focused on the particular condition known as post-traumatic stress disorder (PTSD), an anxiety disorder that occurs as the result of experiencing “a traumatic event in which a threat of serious injury or death was experienced or witnessed and an individual’s response involved intense fear, helplessness, or horror” (Tanielian and Jaycox, 2008). Recent evidence suggests a high prevalence of PTSD among returning active- and reserve-component service members, which has prompted a review of military policies related to the screening and treatment of PTSD.¹

Given that thousands of service members are likely to experience symptoms associated with PTSD—intense physical reaction and feelings of distress when reminded of the event, feelings of detachment and emotional numbness, anxiety, and hyperarousal—for the foreseeable future, understanding the extent to which such symptoms affect the ability of returning service members to readjust to civilian life remains an important area of research. In this report, we focus on the effect of being symptomatic of PTSD on the employment and earnings of members of the National Guard and Reserve (hereafter referred to as *reservists*) in the years following deployment.² Military reservists constitute a compelling study group given their extraordinary use during OEF/OIF and the fact that, unlike most members of the active component, they typically reenter the civilian labor market upon completing their deployment.

A small but growing empirical literature in economics and elsewhere has demonstrated a negative correlation between the occurrence of a mental disorder and earnings, employment, and absenteeism (Chatterji et al., 2007; Chatterji, Alegria, and Takeuchi, 2008; Ettner, Frank, and Kessler, 1997; Alexandre and French, 2001; Berndt et al., 1998; Kessler et al., 1999; Cseh, 2008). However, these studies typically do not examine PTSD or do not distinguish between the effect of PTSD and that of other mental conditions.³ A number of small-sample stud-

¹ Recent studies suggest that 15 to 25 percent of OEF/OIF reservists report symptoms associated with PTSD. See, for example, Milliken, Auchterlonie, and Hoge (2007) and Tanielian and Jaycox (2008).

² See Tanielian and Jaycox (2008) for a comprehensive review of research on the effects of PTSD on other life domains.

³ For example, in the Chatterji, Alegria, and Takeuchi (2008) study, PTSD is one of 14 diagnoses that would cause a respondent to be coded as having a psychiatric disorder.

ies have documented an association between PTSD and behaviors that may negatively affect employment and earnings, including substance abuse (Bremner et al., 1996; McFall, Mackay, and Donovan, 1992), interpersonal problems (Roberts et al., 1982; Riggs et al., 1998), and aggressiveness (Lasko et al., 1994; Byrne and Riggs, 1996; Taft et al., 2007). Using a nationally representative sample of Vietnam War veterans, Jordan et al. (1992) found that veterans with PTSD reported problems across numerous life domains, including low socioeconomic status, poor family adjustment, increased marital problems, and reduced life satisfaction. More recently, Shea et al. (2010) demonstrated that severity of PTSD symptoms was associated with functional impairment in a small sample of National Guard and Reserve OEF/OIF veterans.

Only a handful of studies directly estimate the effect of PTSD on the labor market outcomes of veterans. Simultaneously controlling for wartime experiences and several different types of mental illness, including substance abuse and depression, Savoca and Rosenheck (2000) report that PTSD lowers earnings by 16 percent and has large negative effects on employment. Smith, Schnurr, and Rosenheck (2005) find that intensity of psychiatric symptoms in a sample of Vietnam veterans, all of whom had been diagnosed with PTSD, is also associated with employment status, albeit not with earnings conditional on employment. Focusing on individuals with more recent service, Iversen et al. (2005) find that former UK military personnel who are symptomatic of PTSD are 57 percent less likely to be employed than those who are not, while Richardson et al. (2002) document a similar association for U.S. Gulf War veterans.

Although all of these studies control for some covariates that are related to both labor market outcomes and mental health, most lack data on such critical factors as ability and other dimensions of health.⁴ Thus, whether the associations they document represent causal effects of mental illness on labor market outcomes or the confounding effect of omitted factors remains unclear. McCarren et al. (1995), for example, demonstrate that while income is negatively associated with PTSD for a sample of Vietnam veterans, this association disappears when monozygotic twin pairs who share genetic and family background characteristics are compared. King et al. (1996) show that pre-war characteristics, including family instability and prior trauma, differ systematically among veterans with and without PTSD, but none of the studies cited in the previous paragraph control for such factors.⁵

The recent empirical literature on the effect of mental health more broadly on labor market outcomes has been careful to address the strong likelihood that mental health is endogenous to labor supply decisions in either a structural sense (e.g., poor labor market outcomes cause poor mental health) or a statistical sense (e.g., mental health is a proxy for other, unobserved determinants of labor supply). The challenge is to identify variation in mental health that is exogenous to labor supply decisions. Cseh (2008), for example, uses fixed-effects estimation to account for time-invariant unobservable characteristics that may affect both the incidence of depression and earnings. As might be expected, the negative fixed-effects estimate of the effect of depression on earnings in Cseh (2008) is considerably smaller than the corresponding ordinary least squares (OLS) estimate. Using cross-sectional data, Ettner, Frank, and Kessler (1997) instrument for psychiatric disorders, using parental and prior history of mental

⁴ With the exception of Iversen et al. (2005), all of the cited studies are cross-sectional, and Iversen et al. do not exploit the longitudinal features of their data.

⁵ Other studies that find a correlation between pre-trauma characteristics and subsequent development of PTSD are Breslau, Davis, and Andreski (1995), Lauterbach and Vrana (2001), and Schnurr, Lunney, and Sengupta (2004).

illness, while Chatterji, Alegria, and Takeuchi (2008) employ a bivariate probit model with community-level health resources and a number of disorders with onset during childhood as identifying variables. Other variables used to identify the effect of mental illness on labor market outcomes in bivariate probit models include religiosity, measures of social support, and scores on related mental health items (Hamilton et al., 1997; Alexandre and French, 2001; Ojeda et al., 2010). An advantage of our particular setting relative to that of past researchers is that we are able to employ both panel-data techniques and instrumental variables (IVs) to address the endogeneity of mental health. Relative to factors such as prior health history and other personal characteristics, our instruments, which exploit the inherent randomness of the military assignment process, may provide more credibly exogenous variation in mental health.

In this study, we combine administrative data on PTSD symptoms among reservists returning from recent deployments with longitudinal labor market earnings data to estimate the effect on earnings of being symptomatic of PTSD.⁶ As described in Chapters Two and Three, these administrative data allow us to control for many factors unobservable by past researchers in both civilian and military studies, such as aptitude and pre-deployment mental health. In Chapter Four, we first demonstrate that reservists symptomatic of PTSD are disadvantaged relative to the overall population of reservists along numerous dimensions, including factors determined prior to deployment. These differences render OLS estimates of the PTSD/earnings relationship sensitive to the choice of model covariates. Following the approach of past researchers and controlling only for individual demographics, we find in Chapter Five that being symptomatic of PTSD is negatively correlated with subsequent earnings. However, after employing time-differencing and IVs to address unobserved heterogeneity and the potential endogeneity of PTSD symptoms, the negative correlation with earnings diminishes considerably. First-differenced models imply that being symptomatic of PTSD lowers the earnings of reservists in the first year following deployment by about 1 to 2 percent, while IV models imply effects of about 4 percent. We show in Chapter Six that the small negative effect of being symptomatic of PTSD on earnings from civilian sources disappears after the first year. However, being symptomatic of PTSD continues to exert a substantially negative effect on military earnings as many as four years following deployment. Chapter Seven concludes that while our estimates imply that the average effect of being symptomatic of PTSD on the civilian earnings of reservists is close to zero, the reasons for its strong negative effect on longer-run military earnings deserve further study.

⁶ As in most of the empirical literature estimating the effect of PTSD on subsequent outcomes, we do not observe a formal diagnosis of PTSD in our data. We discuss the implications of this and other measurement issues in Chapter Two.

Estimating the Relationship Between PTSD and Earnings

Consider the following econometric model of annual labor market earnings (civilian earnings plus military earnings) of reservist i in period t , Y_{it} :

$$Y_{it} = \beta PTSD_{it} + X_{it}\delta + \mu_i + \varepsilon_{it}, \quad (2.1)$$

where $PTSD_{it}$ indicates whether reservist i is symptomatic of PTSD at the conclusion of a deployment prior to time t , and X_{it} represents a set of covariates. We hypothesize that the error term in this specification is composed of an individual-level component, μ_i , and an idiosyncratic element, ε_{it} ; β measures the estimated effect of PTSD symptoms on labor market earnings from both civilian and military sources. As would be expected, civilian labor market earnings constitute a substantially larger share of total earnings in the years prior to and following deployment.¹

Past research on PTSD and labor market outcomes has largely ignored the individual-level component of the error term, instead estimating cross-sectional versions of Equation 2.1 with a relatively limited set of covariates. An obvious concern with such a specification is that failure to account for individual-level heterogeneity or other omitted variables correlated with both being symptomatic of PTSD and earnings will bias estimates of β . For example, reservists who experience other health problems as a result of deployment may be relatively susceptible to experiencing symptoms of PTSD. Reservists whose mental or physical health is compromised prior to deployment may also be more susceptible to experiencing symptoms of PTSD following a traumatic experience. Our data allow us to control for a richer set of pre- and post-deployment health conditions and other correlates of labor market performance (such as ability) than was included in earlier studies. Nevertheless, even with a rich set of controls, concerns regarding omitted variables remain. For example, if ability to cope with stressful situations is negatively correlated with being symptomatic of PTSD and positively correlated with earnings, failure to account for coping skills may generate downward-biased estimates of β .

We can account for any time-invariant individual-level characteristics correlated with being symptomatic of PTSD and earnings by first differencing Equation 2.1 to remove μ_i :

$$Y_{i1} - Y_{i0} = \beta(PTSD_{i1} - PTSD_{i0}) + (X_{i1} - X_{i0})\delta + (\varepsilon_{i1} - \varepsilon_{i0}), \quad (2.2)$$

¹ Reservists, when not deployed, earn military pay as a result of inactive-duty training (typically one weekend per month) and active-duty training (typically two weeks per year).

where period 0 denotes the pre-deployment period and period 1 denotes the post-deployment period. An advantage of this approach relative to that of past studies is that it accounts for unobserved individual-level traits that affect labor market outcomes and the likelihood of being symptomatic of PTSD.

Even after controlling for time-invariant individual-level characteristics, time-varying unobservables, if present, could still bias estimates of β . For example, reservists susceptible to experiencing PTSD symptoms following trauma may exhibit lower wage growth prior to deployment for reasons for which we cannot control in our data. One approach that partially addresses the potential bias caused by such unobserved heterogeneity is to estimate versions of Equation 2.2 that allow the growth rate in earnings to depend upon individual characteristics:

$$Y_{i1} - Y_{i0} = \beta(PTSD_{i1} - PTSD_{i0}) + (X_{i1} - X_{i0})\delta + X_i\gamma + (\varepsilon_{i1} - \varepsilon_{i0}). \quad (2.3)$$

This approach is equivalent to permitting some covariates to have time-varying coefficients in Equation 2.1, and it allows us to, for example, model wage growth as a function of the deployment end date in order to capture business-cycle effects.

To account for other potential sources of bias, we also estimate an IV version of Equation 2.3 that uses deployment location as an instrument for being symptomatic of PTSD. In order for this instrument to be valid, it must be correlated with the likelihood of being symptomatic of PTSD but can have no direct correlation with earnings. We demonstrate in Chapter Three that the first condition is easily satisfied—deployment to locations with active combat operations (e.g., Iraq and Afghanistan) is strongly positively correlated with being symptomatic of PTSD at the end of deployment.² These positive correlations are expected, since PTSD, by definition, is precipitated by the experience of a traumatic event, and such events are more likely to occur under combat conditions.

We expect deployment location to be largely unrelated to individual characteristics, because deployments are determined centrally and are generally unresponsive to individual preferences (Lyle, 2006). Deployment location of a service member is determined by his or her unit assignment, and unit assignment is outside the control of the individual soldier, conditional on such characteristics as rank and detailed occupation (for which we can control).³ We demonstrate in Chapter Three that along many observable dimensions, including aptitude and pre-deployment health, reservists deployed to Iraq and Afghanistan are representative of the overall population of deployed reservists. Nonetheless, we acknowledge that some reservists in our data might have volunteered for deployment to a particular location (or actively campaigned to avoid deployment to a particular location), but, on the basis of conversations with Department of Defense (DoD) manpower experts, we expect this number to be small relative to the population of deployed reservists, so we would expect any bias this would introduce to also be small.

We also acknowledge that, although exogenously assigned, deployment location could influence post-deployment earnings through factors other than being symptomatic of PTSD.

² Shen et al. (2009) also establish this pattern for members of the active components.

³ As Lyle (2006) describes, Army active-component soldiers are assigned to division-level units based on the “needs of the Army” and not the preferences of individual soldiers. The “needs of the Army” also determine the mission of individual units. In the reserve components, there is likely to be more choice in assignment, but once a unit is assigned, its mission, including deployment location, is outside the control of the individual soldier.

Most obviously, reservists who are injured in other ways as a result of their deployments could have difficulty reentering the civilian labor market and hence register relatively low post-deployment earnings. Our sample excludes the most seriously injured reservists (those who were evacuated to a permanent medical treatment facility), and our data permit us to control for a long list of post-deployment health conditions. More subtly, it is conceivable that, even conditional on health, combat experience has a positive effect on post-deployment earnings. In the military, combat experience may directly improve chances for promotion, and in the civilian sector, combat experience may inspire greater confidence or otherwise impact labor market success in unobservable ways. However, in the present study, we focus primarily on earnings in the years immediately following deployment, and it seems unlikely that combat experience could influence earnings through these particular channels in the short run.

We conclude this discussion by acknowledging potential limitations of our empirical approach, many of which concern the measurement of PTSD in our data. First, as in most previous studies of PTSD, we observe whether individuals in our data are symptomatic of PTSD rather than formally diagnosed with PTSD. While, as we explain in Chapter Three, being symptomatic of PTSD is strongly correlated with subsequent diagnoses of PTSD, we are nonetheless careful to interpret our estimates as the effect of being symptomatic of PTSD rather than the effect of being diagnosed with PTSD. All else being equal, one might expect that the effect of being diagnosed with PTSD would be greater than the effect of reporting symptoms of PTSD, although there is likely selection in who receives a diagnosis of PTSD, since individuals must choose to see a mental health professional, and the determinants of that choice could be correlated with labor market outcomes independently of PTSD severity. Our data on PTSD are drawn from the Post-Deployment Health Assessment (PDHA) (DD Form 2796). An advantage of using data from the PDHA PTSD screener is that no individual choice is involved in who gets screened.

Second, we must assume that none of the reservists in our sample experienced PTSD symptoms prior to deployment (i.e., $PTSD_{i0} = 0$ in Equation 2.2), since we have no data on PTSD symptoms in the pre-deployment period. Although this assumption is likely to be violated, we have good reasons to believe that the fraction of reservists experiencing PTSD symptoms in the pre-deployment period is small. About 1.8 percent of reservists in our sample who were probably not exposed to combat trauma (i.e., they were deployed outside of Iraq and Afghanistan and did not report firing a weapon or observing casualties) reported two or more symptoms of PTSD following deployment.⁴

Reservists experiencing multiple deployments might be particularly likely to experience PTSD symptoms in the period prior to their most recent deployment, which is the deployment we analyze. Among the 15 percent of reservists in our sample who completed more than one PDHA during our study period (suggesting they had more than one deployment), 3.3 percent reported PTSD symptoms following a previous deployment.⁵ Of those reporting PTSD symptoms following the most recent deployment, 14 percent reported PTSD symptoms following a

⁴ Cesur, Sabia, and Erdal (2011) found that 2.9 percent of individuals surveyed in the National Longitudinal Survey of Adolescent Health reported having ever been diagnosed with PTSD. It is quite possible, however, that this finding overestimates the incidence of PTSD among reservists prior to deployment, since both selection by the military and selection by reservists themselves would tend to lower the fraction of those approved for deployment who were suffering from PTSD.

⁵ The sample for these statistics is restricted to deployments that began one or more months following the end of a reservist's previous deployment.

previous deployment; 2.5 percent of those not reporting PTSD symptoms following the most recent deployment reported PTSD symptoms following a previous deployment. On average, multiple deployments in our sample occurred within a year of each other.

It is not clear how misclassification of this type affects our estimates. On one hand, if a reservist in our treatment group (i.e., symptomatic of PTSD following deployment) should actually serve as a control because he was in fact symptomatic of PTSD prior to deployment, we would think that such misclassification would bias our estimates toward zero. On the other hand, if a reservist in our control group (i.e., not symptomatic of PTSD following deployment) should actually be in our treatment group because he was in fact symptomatic of PTSD prior to deployment, we would think that such misclassification would bias our estimates away from zero. Thus, we do not think this measurement issue is likely to have a large effect on our estimates, both because the percentage of our sample that was in fact symptomatic of PTSD prior to deployment is likely to be small and because the kinds of misclassification just described, which are both likely to be present in our data, work in opposite directions.

In addition, reservists in our data report whether they experience specific symptoms of PTSD near the end of the deployment period. Consequently, we do not know whether they are experiencing these symptoms at the time their earnings are measured one or more years later. Some reservists who report symptoms of PTSD at the end of deployment may not be experiencing them two years later. If that is the case, we might expect the effect of being symptomatic of PTSD at the end of deployment to dissipate with time, because the severity of the condition diminishes with time.

However, it has been shown that PTSD symptoms can first arise many months or even years following the experience of a specific trauma (McFarlane, 2000).⁶ Milliken, Auchterlonie, and Hoge (2007) report that about 12 percent of Army National Guard and Reserve personnel who reported fewer than three symptoms of PTSD at the end of deployment reported three or more symptoms during a follow-up assessment approximately six months later. This misclassification (i.e., individuals who are not symptomatic of PTSD becoming symptomatic of PTSD at a later date) could lead us to underestimate the effect of PTSD symptoms on earnings, although we believe the degree of underestimation is likely to be small, since misclassification probably occurs in a small percentage of our control group (i.e., reservists not reporting PTSD symptoms at the end of deployment).⁷ Although we have no direct evidence that this type of misreporting occurs, it is also conceivable that some service members might choose not to report their PTSD symptoms truthfully because they want to avoid referral for treatment. Conversely, some service members might think that reporting PTSD symptoms will benefit them by delaying future deployment or establishing injury for the purpose of making a future disability claim.

As in other mental health research contexts, separating the effects of PTSD from other, comorbid illnesses, such as depression, remains a formidable challenge. In robustness checks, we control directly for indicators of other psychological problems, but to the extent that PTSD

⁶ Service members might also find it expedient not to report symptoms of PTSD at the end of deployment to avoid further mental health examination at that juncture.

⁷ Hausman, Abrevaya, and Scott-Morton (1998) provide one method for assessing the degree of misclassification in a binary model that involves parameterizing the degree of misclassification in a maximum-likelihood framework. Applying this approach to our data yields evidence of only small degrees of misclassification. However, this approach requires strong functional-form assumptions.

causes these problems, including such controls may lead us to underestimate the true effect of being symptomatic of PTSD. On the other hand, failure to control for such comorbid conditions could cause us to overestimate the effect of being symptomatic of PTSD.

Finally, we have no information on post-deployment mental health treatment for individuals in our sample, so our estimates will combine effects for reservists who do and do not receive treatment for PTSD. Hoge, Auchterlonie, and Milliken (2006) estimate that 31 percent of OIF veterans sought mental health treatment in the year following their deployment. Among a more recent sample of active-component personnel deployed to Iraq, 40 percent of those reporting three or more symptoms of PTSD sought mental health treatment within six months of the end of deployment (Milliken, Auchterlonie, and Hoge, 2007). If treatment ameliorates some of the negative effects of being symptomatic of PTSD, our estimates will be attenuated relative to the effects that would be expected in the absence of treatment.

Data Sources

As noted earlier, our data on PTSD are drawn from the PDHA, which, since April 2003, DoD has required virtually all service members to complete within five days of the end of deployment.¹ The purpose of the PDHA is to screen returning service members for possible health issues and to prescribe follow-up care as necessary. Completed PDHAs are reviewed by a credentialed health care provider in the presence of the service member. The post-deployment PDHA questionnaire is reproduced in Appendix A.

Although we did not directly observe medical diagnoses of PTSD, which can require extensive evaluations, the PDHA includes the Primary Care PTSD (PC-PTSD) screening instrument, and research has demonstrated that positive responses to the four questions it asks about PTSD symptoms are highly correlated with clinical diagnoses of PTSD (Prins et al., 2004; Bliese et al., 2004, 2008).

The questionnaire also includes information about locations and time periods of deployment, other health problems at the end of deployment, and traumatic experiences while in theater. We linked the questionnaire information to data from the Defense Manpower Data Center's Work Experience File, which provides longitudinal information about each reservist, including race, age, residence location, service and component, unit, rank, military occupation, and, for enlisted members, score on the Armed Forces Qualifying Test (AFQT), an aptitude test that is highly predictive of civilian labor market earnings (Neal and Johnson, 1996).² We also draw from the Pre-Deployment Health Assessment (DD Form 2795, reproduced in Appendix B), which reports information on health prior to deployment and was available for roughly 67 percent of our sample.

Our analysis includes reservists who completed a PDHA between June 1, 2003, and December 31, 2006.³ A total of 315,295 valid PDHAs are available for this period; 59 percent

¹ Specifically, all active- and reserve-component service members deployed outside the continental United States to a land-based location with no fixed U.S. medical treatment facility for 30 or more continuous days must complete the PDHA upon redeployment. Commanders in other duty stations were strongly encouraged to require the screening. While the PDHA process has existed since 1998, it was not fully implemented until 2002–2003 (see DoD, 2002).

² Small amounts of data are missing for some fields, such as AFQT. When applicable where data are missing, we impute the population mean and include an indicator for missing data as an additional control.

³ We also exclude roughly 2,300 individuals with missing or erroneous arrival-date information and 2,000 individuals with missing PDHA-item responses. About 35 percent of our sample completed more than one PDHA during this period (primarily because of multiple deployments). In this research, we use only the most recently completed PDHA for a given individual.

of those completing the PDHA reported service in Iraq or Afghanistan.⁴ One concern with focusing on individuals who completed a PDHA is that, despite the mandatory nature of the assessment, there may be self-selection in its completion. However, along observable dimensions, this self-selection appears to be unimportant. Hoge, Auchterlonie, and Milliken (2006, Table 2) demonstrate that for the overall force, the demographics of noncompleters are generally comparable to those of completers, although there are some differences in completion rates across services and components. Nevertheless, we acknowledge that self-selection in PDHA completion on unobservables is potentially problematic.

The PC-PTSD screening instrument has the following form (item 12 in Appendix A):

Have you ever had any experience that was so frightening, horrible, or upsetting that, in the past month, you . . .

- Have had any nightmares about it or thought about it when you did not want to?
- Tried hard not to think about it or went out of your way to avoid situations that remind you of it?
- Were constantly on guard, watchful, or easily startled?
- Felt numb or detached from others, activities, or your surroundings?

Following Hoge, Auchterlonie, and Milliken (2006), we coded individuals answering positively to two or more of these questions as being “symptomatic of PTSD.” As previously noted, positive responses to these four items are highly correlated with subsequent diagnoses of PTSD. Bliese et al. (2008) report that a threshold of two positive responses on the four items has a sensitivity of 0.85 and a specificity of 0.76.⁵ They also report that the screener performs as well as the more commonly used PTSD Checklist (PCL), which covers the 17 elements in the *Diagnostic and Statistical Manual of Mental Disorders*, 4th Edition (DSM-IV) diagnostic criteria for PTSD. In robustness checks, we investigated specifications in which the threshold is increased to three or more positive responses and four positive responses.

Annual earnings data were obtained by matching the PDHA and other available records to the Social Security Administration’s (SSA’s) Master Earnings File, using the reservists’ Social Security numbers.⁶ Our total earnings measure is earnings subject to Medicare taxes, which includes earnings from both civilian and military sources and is not subject to topcoding. Using military pay files, we also constructed a measure of military pay that enabled us to decompose total annual earnings into civilian and military components.⁷ Because our earnings data are available on a calendar-year basis, but deployments typically begin or end mid-year,

⁴ Twenty percent of the sample was deployed to the continental United States, 18 percent to Kuwait or Qatar, and 5 percent to Bosnia or Kosovo.

⁵ Sensitivity measures the proportion of true positives, and specificity measures the proportion of true negatives.

⁶ This match was conducted by staff at SSA. To preserve confidentiality, the matched data were analyzed at SSA using programs written by the authors. The individual-level matched data were never released to the authors.

⁷ Military pay includes regular pay, bonuses, cash allowances, and a measure of the implicit value of the federal tax advantage accorded allowances and pay received while serving in a combat zone. Military cash allowances and bonuses, which are not subject to Federal Insurance Contributions Act (FICA) taxes, and an estimate of the so-called tax advantage are added to Medicare earnings to arrive at total earnings. Medicare earnings are net of disability payments individuals might receive from DoD or the Veterans Administration. Although military disability payments are unconditional on labor supply, it is possible that they depress labor supply through income effects. Thus, our estimates of earnings effects encompass the disabling effect of PTSD, as well as potential income effects associated with disability payments.

we use the first complete calendar years immediately prior to and following the deployment start and end dates as the pre- and post-deployment years for the purposes of earnings measurement.⁸ Dollar amounts are adjusted to constant 2004 dollars.

⁸ We include fixed effects for end month of deployment and for pre- and post-deployment calendar years in our analysis to account for differences across individuals in the time between deactivation and the calendar year in which earnings are measured.

How Do Reservists Symptomatic of PTSD Compare with the Overall Sample Population?

Table 4.1 presents summary statistics describing the average pre- and post-deployment characteristics of our overall sample, along with separate averages for service members symptomatic of PTSD and serving in Iraq, Kuwait, and Afghanistan—deployment locations in which reservists are at an elevated risk of combat.¹ Among reservists returning from deployments between June 2003 and December 2006, 8.6 percent are symptomatic of PTSD, with those deployed to Iraq, Kuwait, and Afghanistan having appreciably higher percentages than those deployed to other areas (11.5 percent versus 2.1 percent). Overall, 11 percent of all reservists reported firing their weapon while deployed, but the incidence of weapon use was 35 percent among those ultimately symptomatic of PTSD and 16 percent among those deployed to higher-risk locations.

Table 4.1 indicates that reservists symptomatic of PTSD at the end of their deployment were disadvantaged across several domains, including factors determined prior to deployment. Reservists symptomatic of PTSD earned substantially less than average in both their military and civilian employment. These reservists also exhibited lower educational attainment and scores on the AFQT. The average pre-deployment annual earnings of reservists symptomatic of PTSD were \$6,027 less than those of reservists not symptomatic of PTSD, a difference of 17 percent. Reservists symptomatic of PTSD also tended to reside in areas with slightly lower income and higher shares of single-parent families and were drawn disproportionately from the Army and from lower ranks. Prior to deployment, reservists ultimately symptomatic of PTSD reported worse-than-average general health and were considerably more likely to have sought recent treatment for a mental health issue than reservists not symptomatic of PTSD. Following deployment, reservists symptomatic of PTSD also exhibited a relatively high incidence of other health problems, particularly symptoms associated with depression. Overall, the evidence in Table 4.1 strongly suggests that the propensity to experience PTSD symptoms at the end of deployment is correlated with individual characteristics that are established prior to the experience of the trauma that leads to PTSD.

Table 4.1 also demonstrates that reservists deployed to locations that have a higher risk of combat are similar to those deployed to lower-risk locations, although important differences remain. The population of reservists symptomatic of PTSD consists disproportionately of minorities, while the racial distribution of reservists deployed to high-risk locations roughly mirrors that of those deployed to lower-risk locations. Educational attainment is slightly lower

¹ The period of deployment for some of those in our sample includes the initial ground invasion of Iraq (March 2003); therefore, many service members who reported deployments to Kuwait also saw service in Iraq.

Table 4.1
Summary Statistics

Characteristic	Overall	<2 PTSD Symptoms	2+ PTSD Symptoms	Deployed to Low-Risk Location	Deployed to Iraq, Afghanistan, or Kuwait
% 2+ PTSD symptoms	8.56	0.00	100.00	2.06	11.45
Pre-deployment annual earnings (\$)					
Total	36,321	36,837	30,810	39,565	34,878
Military	10,293	10,388	9,275	10,675	10,123
Civilian	26,028	26,449	21,535	28,890	24,755
Post-deployment annual earnings (\$)					
Total	39,716	40,303	33,450	43,435	38,062
Military	11,125	11,201	10,307	12,906	10,333
Civilian	28,591	29,102	23,143	30,529	27,730
Demographics					
% male	88.76	88.92	87.11	87.02	89.54
% white	70.61	71.14	64.94	71.82	70.07
% African-American	15.26	14.94	18.62	15.82	15.00
% Hispanic	8.21	8.03	10.20	7.74	8.42
% high school graduate	87.25	87.49	84.60	89.68	86.17
AFQT score	59.37	59.60	56.90	59.78	59.19
Age (years)	32.64	32.73	31.74	34.03	32.03
Military service (%)					
Army	80.49	79.53	90.74	72.30	84.14
Enlisted	86.39	85.86	92.04	84.17	87.37
Low rank	8.92	8.81	10.10	7.38	9.61
Infantry/tank/artillery	8.75	8.38	12.62	9.10	8.59
Deployed to Iraq	52.54	49.81	81.66	0.00	75.91
Deployed to Afghanistan	6.76	6.91	5.15	0.00	9.76
Fired weapon during deployment	11.46	9.24	35.19	0.31	16.42
Residence ZIP code labor market characteristics					
Median annual household income (\$)	38,815	38,933	37,574	39,755	38,400
% not working	6.36	6.30	6.93	5.91	6.56
% single-parent families	13.08	13.04	13.50	12.48	13.34

Table 4.1—Continued

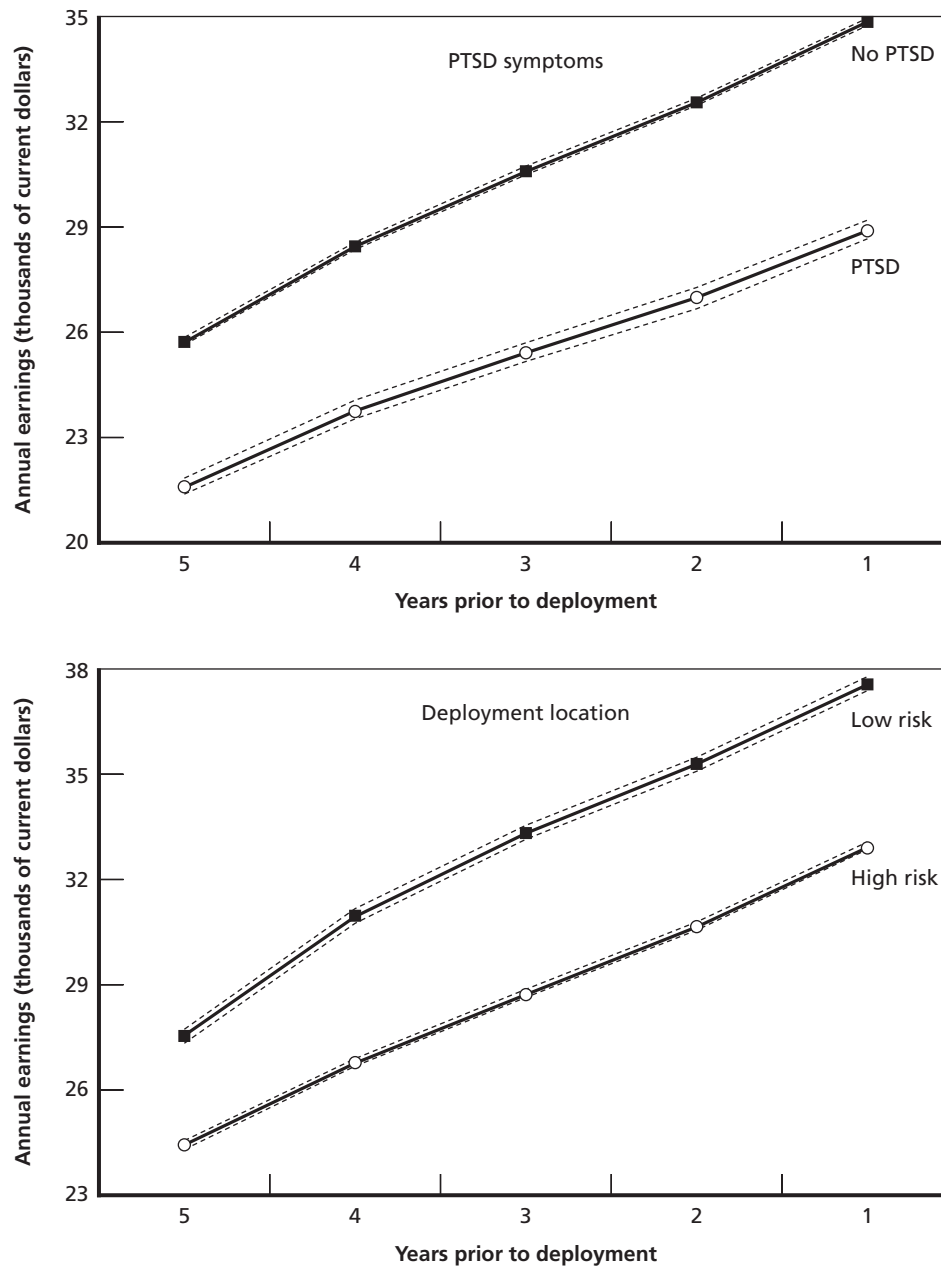
Characteristic	Overall	<2 PTSD Symptoms	2+ PTSD Symptoms	Deployed to Low-Risk Location	Deployed to Iraq, Afghanistan, or Kuwait
Pre-deployment health (%)					
Sought mental health treatment	1.53	1.44	2.55	1.45	1.57
Had any medical problems	12.03	11.73	15.22	11.05	12.47
Recent light duty	5.47	5.36	6.65	5.22	5.58
Rated health excellent	31.94	32.32	28.49	35.57	31.08
Post-deployment health (%)					
Hospitalized while deployed	7.01	6.16	16.13	5.82	7.54
Reports “feeling down”	13.72	9.98	53.65	7.95	16.28
Has headaches	29.34	26.40	60.66	17.33	34.68
Has back pain	32.37	29.43	63.82	19.72	38.00
Has memory problems	8.59	6.31	32.97	3.94	10.66
N	315,295	288,302	26,993	97,060	218,235

NOTE: For all characteristics, differences between the *PTSD* and *No PTSD* populations and the *Low-risk location* and *Iraq, Afghanistan, and Kuwait* populations are statistically significant at conventional levels. Dollar amounts have been adjusted to 2004 dollars.

among those deployed to Iraq and Afghanistan, but AFQT scores are similar. In contrast to those ultimately symptomatic of PTSD, individuals deployed to Iraq and Afghanistan report pre-deployment health similar to that of the overall population. Nevertheless, as indicated in Table 4.1, reservists deployed to hazardous areas have considerably lower earnings prior to deployment than those deployed to low-risk areas. One potential explanation for this pattern is that while deployment location is likely to be exogenous conditional on occupation and rank for the involuntarily deployed, weaker labor market prospects may induce some individuals to volunteer for deployment. Because of these observed differences, our IV analysis focused on the first-differenced specifications that explicitly control for pre-existing differences across groups in earnings. Unsurprisingly, there is also greater incidence of other adverse health conditions, such as headaches and back pain, among those deployed to Iraq and Afghanistan.

In addition to examining earnings in the year prior to deployment, we examined earnings several years prior to deployment to ascertain whether pre-deployment earnings trajectories differ among those who are symptomatic of PTSD following deployment and those who are not. Figure 4.1 plots average earnings in the five years prior to deployment of reservists who are and are not symptomatic of PTSD following deployment. Consonant with the discussion above, earnings prior to deployment are substantially lower among those symptomatic of PTSD following deployment. Nevertheless, the trend in earnings prior to deployment across the two groups is similar. Similarly, pre-deployment earnings differences between those deployed to Iraq and Afghanistan and those deployed to other locations are sizable, but time trends in earnings are comparable across the two groups. This pattern suggests that first differencing as in Equation 2.2 should be effective at eliminating bias due to unobserved heterogeneity correlated with deployment location, PTSD symptoms, and earnings.

Figure 4.1
Trends in Pre-Deployment Earnings, by Eventual PTSD Symptoms and Deployment Location



NOTE: Dotted lines denote 95-percent confidence intervals for average earnings.

RAND TR1006-4.1

The Effects of Being Symptomatic of PTSD on Earnings in the Year Following Deployment

This chapter presents our regression estimates in four sections. We begin with estimates derived from the cross-sectional specification represented by Equation 2.1, showing how the estimated effect on annual earnings of being symptomatic of PTSD varies as we expand the covariates included in the vector X_{it} . We then report first-differenced estimates (Equations 2.2 and 2.3) and first-differenced estimates in which we instrument for being symptomatic of PTSD. Finally, we present the results of a number of robustness checks.

Cross-Sectional Estimates

Table 5.1 presents cross-sectional regression estimates of the effect of being symptomatic of PTSD on post-deployment earnings in the year following deployment. The coefficient estimate of $-\$6,852$ reported in column 1 indicates that reservists symptomatic of PTSD earned $\$6,852$ less than those who were not symptomatic of PTSD (about 17 percent of mean earnings) in the year following deployment, a difference that is statistically significant. The specification in column 2 controls for a host of demographic characteristics, including age and age-squared, sex, race (white, African-American, and Hispanic), education (six categories), state of residence, military occupation (36 categories), rank, and component. This specification also includes controls for year and month of deployment (categorical). The inclusion of these demographic controls in the model reduces the coefficient estimate on being symptomatic of PTSD to $-\$2,092$, or 5.3 percent of earnings. The estimate in column 2 is about one-third as large as the reported effect of PTSD on earnings in Savoca and Rosenheck (2000), who employed a similar set of controls.¹

Column 3 of Table 5.1 adds controls for AFQT and pre-deployment health, including indicators for whether the reservist had recently sought mental health treatment, whether the reservist reported medical problems, and self-rated overall health prior to deployment. The estimated coefficient on being symptomatic of PTSD in this specification falls slightly, to $-\$1,936$. The final column of Table 5.1 adds controls for deployment occupation and detailed measures of post-deployment health, including whether the reservist was hospitalized while deployed, the number of sick days while deployed, and separate indicators for experiencing symptoms of various health conditions, such as back pain, fever, rash, and vision problems. After controlling

¹ The fact that the PDHA PTSD screen differs from that used by Savoca and Rosenheck (2000) could also account in part for the differences between our estimates and those reported in that study.

Table 5.1
OLS Estimates of the Relationship Between Post-Deployment Earnings and Being Symptomatic of PTSD

Explanatory Variable	1	2	3	4
PTSD	-6,852** (167)	-2,092** (137)	-1,936** (137)	-1,229** (146)
Male		6,453** (131)	6,364** (131)	6,087** (133)
Race (relative to other)				
White		426** (113)	442** (113)	440** (113)
African-American		-483** (150)	-490** (151)	-358* (151)
Hispanic		-75 (162)	-77 (163)	5 (164)
Age		3,241** (40)	3,233** (40)	3,248** (40)
Age-squared		-35.6** (0.56)	-36.6** (0.57)	-37** (1)
Education (relative to less than high school)				
High school graduate		5,375** (242)	5,247** (242)	5,242** (241)
Some college		6,019** (259)	5,965** (259)	5,966** (258)
Bachelor's degree		8,582** (305)	8,620** (306)	8,601** (305)
Advanced degree		16,408** (463)	16,244** (462)	16,202** (462)
AFQT score			71** (10)	70** (10)
AFQT ² score			-0.68** (0.08)	-0.68** (0.08)
Pre-deployment health				
Recently sought mental health treatment			-1,497** (414)	-1,361** (414)
Has medical problem			- 679** (161)	- 523** (162)
Recent light duty			361 (259)	547* (260)
Self-rated health (relative to excellent)				
Very good			-1,040** (127)	-1,000** (127)
Good			-2,107** (135)	-1,992** (136)

Table 5.1—Continued

Explanatory Variable	1	2	3	4
Hospitalized while deployed				-833** (155)
Number of sick periods while deployed				-135** (15)
Post-deployment health problems				
Back pain				-306** (100)
Chest pain				-1,018** (147)
Chronic cough				-341* (136)
Diarrhea				48 (107)
Fever				538** (149)
Joint problems				108 (109)
Numb hands or feet				-308* (126)
Rash				-12 (137)
Ringing ears				-114 (131)
Runny nose				-84 (112)
Red eyes/tearing				17 (151)
Dim vision				-817** (229)
Vomiting				23 (167)
N	315,347	314,236	314,102	314,100
R ²	0.004	0.407	0.41	0.41
Control for time of departure, state, service, rank, and occupation?	No	Yes	Yes	Yes
Control for deployment occupation?	No	No	No	Yes

NOTES: Coefficient estimates are from a regression of annual earnings in the calendar year following deployment on an indicator for being symptomatic of PTSD and covariates. Unreported controls include indicators for year of deployment, departure month, post-deployment state of residence, rank, service, military occupation prior to and during deployment, and missing variables. Heteroskedasticity-robust standard errors are reported in parentheses.

* denotes statistical significance at the 5-percent level, and ** denotes significance at the 1-percent level.

for the full set of available covariates, we estimated an effect of being symptomatic of PTSD on earnings of $-\$1,229$, or roughly 3 percent of earnings. While statistically significant, the earnings effect we observed after controlling for a wider set of individual characteristics is noticeably below the estimated effect of being symptomatic of PTSD when a more limited set of demographic covariates (column 2) is controlled for, as has typically been done in past studies.

First-Differenced Estimates

Given the finding reported in Chapter Three that reservists symptomatic of PTSD differ from the overall population of reservists in ways correlated with earnings, the sensitivity of our cross-sectional regression estimates to the choice of control variables is not surprising. Although the rich set of control variables included in column 4 of Table 5.1 handles many potential sources of omitted-variable bias, fixed unobserved heterogeneity may remain and bias our estimate of the causal effect on earnings of being symptomatic of PTSD.

Table 5.2 presents first-differenced estimates (Equations 2.2 and 2.3) that control for the influence of any remaining fixed unobserved heterogeneity. The specification reported in column 1 includes no additional controls, while that reported in column 2 includes a basic set of demographic controls; the specifications in columns 3 and 4 add controls for pre- and post-deployment characteristics. The simple first-differenced specification with no controls (column 1) implies that being symptomatic of PTSD lowers annual earnings by \$826 (2 percent), considerably less than the most restricted OLS estimate (Table 5.1, column 4). Controlling for demographics and pre-deployment characteristics (columns 2 and 3) changes the estimated effect on earnings of being symptomatic of PTSD only slightly. This pattern of results is consistent with the notion that the major source of bias in estimating the effect on earnings of being

Table 5.2
First-Differenced Estimates of the Effect on Earnings of Being Symptomatic of PTSD

Explanatory Variable	1	2	3	4
PTSD	−826** (114)	−731** (113)	−695** (113)	−438** (121)
N	315,347	315,347	315,213	315,211
R ²	0.001	0.024	0.024	0.025
Control for demographics?	No	Yes	Yes	Yes
Control for pre-deployment characteristics?	No	No	Yes	Yes
Control for post-deployment health and deployment characteristics?	No	No	No	Yes

NOTES: The coefficient estimates are obtained from a regression of the first difference of annual earnings on an indicator for being symptomatic of PTSD. The demographic controls include age, post-deployment state of residence, military occupation, rank, and year and month of deployment. The pre-deployment controls include AFQT score and indicators for self-assessed general health, medical problems, mental health concerns, and light duty in the pre-deployment period. Post-deployment and deployment controls include indicators for deployment occupation, hospitalization status while deployed, the occurrence of 13 different medical symptoms, and a continuous measure of sick days while deployed. Heteroskedasticity-robust standard errors are reported in parentheses.

* denotes statistical significance at the 5-percent level, and ** denotes significance at the 1-percent level.

symptomatic of PTSD is time-invariant heterogeneity, and once this heterogeneity is properly accounted for, pre-deployment characteristics provide little additional information. Adding deployment and post-deployment controls to the differenced specification (column 4) diminishes the estimated negative effect of being symptomatic of PTSD to about 1 percent, largely because of the influences of other medical problems that tend to co-occur with PTSD symptoms. The unreported coefficients on the health-related control variables included in column 4 generally accord with intuition—for example, wage growth is lower among those reporting hospitalizations or back pain. The first-differenced and OLS estimates are consistent in finding a statistically significant but small short-run earnings effect of being symptomatic of PTSD, on the order of –1 percent to –2 percent.

Instrumental-Variable Estimates

An alternative means of addressing the potential endogeneity of being symptomatic of PTSD is to find an IV that is not directly correlated with earnings but that is correlated with being symptomatic of PTSD. We consider a set of indicators for deployment location as instruments. As discussed previously, deployment-location indicators are valid IVs if reservists are exogenously assigned to serve in particular theaters conditional on their observable characteristics at the time of deployment. In some locations, there is clearly greater demand for certain types of service members—e.g., truck drivers and infantry—but we explicitly control for occupation and rank in our analysis. One potential drawback of using deployment location as an instrument is that deployment to particular locations might affect earnings in ways other than being symptomatic of PTSD. Fortunately, we have available a number of control variables that can account for the primary alternative factor that could cause deployment to affect earnings, namely, health conditions other than PTSD.

Table 5.3 presents our IV estimates. Because our endogenous variable is binary, we estimate the first-stage IV regression using a probit model and calculate standard errors following the procedure described in Wooldridge (2002).² As in Table 5.2, earnings are first-differenced to remove individual heterogeneity, and a full set of controls is included in these specifications. The first-stage relationship between deployment location and being symptomatic of PTSD is both practically large and sufficiently precise even after controlling for other individual characteristics. The first-stage chi-squared statistic on the excluded instruments is large, which ameliorates concerns regarding weak instruments.

The IV results also suggest a modest negative effect on earnings of being symptomatic of PTSD. The estimate, –\$1,540, represents about 4 percent of annual earnings and is statistically significant. While it does not exclude the smaller negative effects obtained using OLS in levels and first-differences, the IV estimate is sufficiently precise to rule out negative effects of more than about 8 percent of earnings, appreciably less than is found in studies that do not account for endogeneity of PTSD, such as Savoca and Rosenheck (2000). Overall, the IV analysis points to a conclusion similar to that of the fixed-effects and OLS analysis, namely, any negative causal effect of being symptomatic of PTSD on short-run earnings is relatively small.

² An advantage of this approach is that it is robust to misspecification of the equation determining PTSD (White, 1982).

Table 5.3
IV Estimates of the Effect on Earnings of Being Symptomatic of PTSD

Characteristic	IV Estimate
Second-stage: effect of being symptomatic of PTSD on earnings	
PTSD	−1,540* (766)
First-stage: effects of deployment location on being symptomatic of PTSD	
Reference group: deployed to other	
Deployed to Kuwait	0.00557** (0.00107)
Deployed to Iraq	0.0623** (0.00140)
Deployed to Afghanistan	0.0291** (0.00234)
Deployed to Qatar	−0.00792** (0.00285)
Deployed to Turkey	0.0127 (0.00935)
Deployed to Uzbekistan	−0.00823 (0.00653)
Deployed to Bosnia	−0.0214** (0.00697)
Deployed to Kosovo	−0.0356** (0.00499)
Deployed to Continental United States	−0.0130** (0.00199)
N	312,521
Likelihood-ratio test statistic for instruments [$\chi^2(9)$]	3,386.7
Include demographic controls?	Yes
Control for pre- and post-deployment characteristics?	Yes

NOTES: Annual earnings are measured in first differences. Separate indicators for deployment to Qatar, Afghanistan, Bosnia, Iraq, Turkey, Uzbekistan, Kosovo, Kuwait, and the continental United States (with deployment to other locations as a reference group) are used as instrumental variables. Estimation of the first stage is accomplished using probit regression; marginal effects from the first stage are reported here. Likelihood-ratio statistics are reported for a test of joint significance of the instruments in the first-stage probit. Controls are the same as those for column 4 of Table 5.2. Heteroskedasticity-robust standard errors are reported in parentheses.

* denotes statistical significance at the 5-percent level, and ** denotes significance at the 1-percent level.

Additional Robustness Checks

Table 5.4 presents additional OLS first-differenced (OLS-FD) and IV first-differenced (IV-FD) specifications that focus on particular subgroups of interest or modify the baseline specifications reported in Tables 5.2 and 5.3 to assess the robustness of our basic conclusions. The first line of Table 5.4 shows estimated coefficients for the baseline specifications reported in column 4 of Tables 5.2 and 5.3.

Table 5.4
Additional Specifications

Specification	OLS-FD	IV-FD
0. Original	–438** (121)	–1,540* (766)
1. Indicator for underemployment as outcome	0.0162** (0.00184)	0.0345** (0.00986)
2. Change in log(earnings) as outcome	–.0302** (0.00558)	–.138** (0.0314)
3. Three or more positive responses on PTSD screen	–805** (157)	–997 (1020)
4. Four positive responses on PTSD screen	–796** (219)	–1,770 (1690)
5. Army only	–362** (126)	–1,150 (775)
6. Deployments to Kuwait, Iraq, and Afghanistan only	–274* (126)	–768 (981)
7. Females only	–99.0 (322)	–1,950 (1730)
8. Control for additional post-deployment health conditions	–347** (122)	–1,110 (725)
9. Control for additional health conditions and depression	–80.8 (124)	–160 (623)

NOTE: Each entry is the result of a unique regression (see the notes to Tables 5.2 and 5.3). Earnings measures are differenced and all regressions include the full set of available controls (Table 5.2, column 4). Specification 1 uses an indicator for earnings below \$5,356 (federal minimum wage for a part-time worker) as the dependent variable (mean = 0.06). Specification 2 uses the difference between log(earnings) in the year after deployment and log(pre-deployment earnings) as the dependent variable. Specification 3 recodes the PTSD indicator so that it equals 1 only for individuals answering yes to three or more of the PTSD screening questions (4.7 percent of the sample), and specification 4 recodes the indicator to apply to those answering yes to all four questions (2.3 percent of the sample). Specifications 5 through 9 limit the analysis to the indicated sample. Specifications 10 and 11 add indicators for reports of headaches, indigestion, lightheadedness, weakness, memory problems, muscle pain, difficulty breathing, and fatigue in the post-deployment assessment as additional controls, and specification 11 adds three indicators for depressive symptoms and a measure of health change during deployment as further controls. Heteroskedasticity-robust standard errors are reported in parentheses.

* denotes statistical significance at the 5-percent level, and ** denotes significance at the 1-percent level.

The first specification tests whether being symptomatic of PTSD increases the likelihood of having low earnings. Many previous studies of the labor market effects of mental illness have found a large effect on unemployment. Unemployment (or zero earnings) is not a revealing outcome in the present context, because individuals in our sample are highly likely to be employed by the armed forces following deployment. Consequently, we investigated the effect on being underemployed, which we define as having annual earnings below \$5,356, a level consistent with full-year part-time employment at the federal minimum wage. Among our sample, 6 percent were underemployed in the post-deployment year by this measure. Using OLS (but without first differencing), we found a substantial impact of being symptomatic of PTSD on underemployment: Our coefficient estimate suggested a 25-percent increase in the likelihood of underemployment among those symptomatic of PTSD. The IV-FD point esti-

mates indicate an even larger effect of being symptomatic of PTSD on underemployment (3.6 percentage points). These results accord with those of Iversen et al. (2005), who also found large employment effects of PTSD.

The second specification uses earnings measured in log rather than levels as the dependent variable. This alternative functional form generates findings consistent with the baseline using OLS-FD and slightly larger effects using IV-FD. The third specification defines being symptomatic of PTSD as having reported three or more symptoms, and the fourth specification defines it as having reported all four symptoms. These more stringent definitions increase the likelihood that individuals responding positively to these screening questions would in fact be formally diagnosed with PTSD. Approximately 5 percent of our sample reported experiencing three or more symptoms of PTSD, and 2 percent of the sample reported experiencing all four symptoms.

As expected, the OLS-FD point estimates indicate a stronger negative impact of being symptomatic of PTSD when coding the PTSD screen based upon three or more or four positive responses, although these estimates do not differ significantly from the baseline estimates reported in Tables 5.2 and 5.3. The IV-FD estimates for specifications 3 and 4 are imprecise.

Limiting the analysis to the Army or to those serving in Iraq, Afghanistan, and Kuwait (specifications 5 and 6) yields results similar to the baseline. Combat exposure and reporting PTSD symptoms are more likely among reservists serving in these locations, making these subpopulations of particular interest. These results are statistically indistinguishable from the baseline estimates.³ Specification 7 limits the sample to females. The OLS-FD estimate of $-\$99$ for females is smaller than the $-\$438$ estimated for the entire sample, which suggests that the effect on earnings of being symptomatic of PTSD may be less pronounced for this subpopulation.

The final two robustness checks add additional indicators for post-deployment health status to the set of controls. As noted in Chapter Two, a particular challenge in identifying the independent effect of mental illness is the existence of comorbidities across medical conditions, with no clearly defined causal pathways across illnesses. Up to this point, in controlling for other health effects, we have focused on symptoms that are likely to capture health conditions that are clearly distinct from health problems associated with PTSD (for example, fevers and vision problems). However, conditions that tend to co-occur with PTSD, such as memory problems, may exert an independent effect on earnings, in which case, failing to control for them might suggest a larger effect of PTSD than that which is attributable solely to post-traumatic stress.

In specification 8, we add controls for a set of conditions that may represent distinct medical problems but could also plausibly arise as side effects of PTSD, such as weakness, fatigue, and indigestion. As expected, controlling for these additional health problems reduces the estimated effect of being symptomatic of PTSD, although it remains statistically significant when OLS is used. In specification 9, we add controls for indicators of depression. Given the strong possibility that PTSD can lead to depression, including such indicators is likely to overcontrol for comorbid conditions. In this specification, the earnings effect of being symptomatic of PTSD is no longer statistically distinguishable from zero, using both OLS-FD and IV-FD.

³ Because incidence of PTSD symptoms varies between those deployed to Iraq, Kuwait, and Afghanistan, we can still use deployment location as an instrument in this more limited sample.

Longer-Run Effects on Earnings of Being Symptomatic of PTSD

Our discussion so far has focused on the effects of being symptomatic of PTSD on earnings in the year immediately following deployment. Although these effects appear relatively modest, it is possible that labor market effects of being symptomatic of PTSD are not fully manifest until many years following the traumatic experience. For some subset of the reservist population, PTSD symptoms may worsen over time, leading to greater impairment and potentially larger earnings effects. Moreover, small disruptions to labor market activity immediately following deployment may become magnified over time if experience or skills acquired in prior periods affect opportunities for skill development in future periods. However, it is possible that for other reservists, the symptoms of PTSD may diminish with time, lessening the impact of the condition on labor market performance.

Our earnings data extend through 2007, so for reservists ending a period of deployment between 2003 and 2005, we can observe multiple years of post-deployment earnings. For example, for those ending deployment in 2003, we observe earnings for the next four years (2004 through 2007). Following the approach of Chapter Five, we estimate the effect of being symptomatic of PTSD at the end of deployment on earnings in these later years to assess whether the impacts of this condition grow or attenuate over time. The top panel of Table 6.1 shows OLS-FD estimates of the effect of being symptomatic of PTSD on earnings one, two, three, and four years following deployment.¹ We present these estimates separately by deployment end date so that within a particular cohort, the sample does not change with years since deployment.

The first entry in Table 6.1 replicates the finding reported in Table 5.2, column 4, of a $-\$438$ effect on annual earnings of being symptomatic of PTSD, using the full sample. Other entries in the first row of Table 6.1 are of similar magnitude, indicating that focusing on particular subsets of the sample based on timing of deployment does not appreciably alter this estimate. However, effects in year 2 are appreciably greater than the year 1 effects, ranging across samples from $-\$1,235$ to $-\$2,150$. For those ending deployment in 2003, the negative effect of being symptomatic of PTSD increases from $-\$655$ in year 1 to $-\$2,443$ (roughly 6 percent of earnings) in year 4. Thus, the pattern in Table 6.1 clearly indicates that the negative effect of being symptomatic of PTSD increases with time since deployment.

To further illuminate the source of these earnings patterns, the bottom panels of Table 6.1 decompose total earnings effects into those attributable to civilian earnings and those

¹ We also estimated IV versions of these specifications, using deployment location as instruments. Generally, the IV estimates were statistically indistinguishable from the OLS estimates, but confidence intervals for some IV estimates, particularly those involving smaller samples, were wide.

Table 6.1
Effects of Being Symptomatic of PTSD on Earnings in Later Years

Item Affected	OLS-FD Regression Estimates			
	Deployment Ended in 2003– 2006	Deployment Ended in 2003– 2005	Deployment Ended in 2003– 2004	Deployment Ended in 2003
Total earnings				
Post-deployment year 1	–438** (121)	–471** (133)	–336 (194)	–655 (351)
Post-deployment year 2		–1,235** (147)	–1,499** (210)	–2,150** (423)
Post-deployment year 3			–1,497** (246)	–2,548** (488)
Post-deployment year 4				–2,443** (521)
Military earnings				
Post-deployment year 1	396** (100)	339** (108)	622** (164)	686* (346)
Post-deployment year 2		–531** (113)	–610** (165)	–1,276** (353)
Post-deployment year 3			–1,003** (173)	–1,902** (355)
Post-deployment year 4				–1,966** (360)
Civilian earnings				
Post-deployment year 1	–834** (126)	–810** (139)	–958** (206)	–1,340** (394)
Post-deployment year 2		–704** (153)	–888** (220)	–874 (452)
Post-deployment year 3			–493 (255)	–646 (507)
Post-deployment year 4				–477 (549)
N	315,211	260,201	142,258	51,342

NOTES: These regressions are analogous to those in column 4 of Table 5.2, but they consider earnings in years beyond the first post-deployment year. The notes for Table 5.2 identify the control covariates included in each specification. Each table entry is a result of a unique regression. Each column examines a particular sample of reservists based on deployment end date. Heteroskedasticity-robust standard errors are reported in parentheses.

* denotes statistical significance at the 5-percent level, and ** denotes significance at the 1-percent level.

attributable to military earnings. A clear pattern emerges. In the year immediately following return from deployment, almost all of the earnings effect of being symptomatic of PTSD is attributable to civilian earnings. However, in subsequent years, the negative impact of being symptomatic of PTSD on civilian earnings approaches zero. For reservists ending deployment

in 2003, the negative civilian-earnings effect falls from a statistically significant estimate of $-\$1,340$ in year 1 to a statistically insignificant estimate of $-\$477$ in year 4. Thus, on average, the negative impact of being symptomatic of PTSD on civilian earnings appears to be short-lived.

We observe the reverse pattern for military earnings. For all four samples, the estimated effect of being symptomatic of PTSD on military earnings is positive in the first year following deployment. However, this effect turns negative in year 2 and increases in magnitude in later years. For reservists ending deployment in 2003, the effect of being symptomatic of PTSD on military earnings is $-\$1,966$ four years following deployment—about 18 percent of average military earnings. Thus, virtually all of the negative effect of being symptomatic of PTSD on total earnings two to four years following deployment is explained by declining military earnings.

An obvious explanation for the greater decline in military earnings of reservists symptomatic of PTSD is higher separation rates from the military. Table 6.2 presents coefficients from regressions analogous to those in Table 6.1, in which the dependent variable is an indicator for whether a reservist has permanently separated from the military by the end of the n th year following deployment. Among all reservists, the rate of permanent separation rises from 14 percent in the year immediately following the end of deployment to 33 percent four years after deployment. However, the results indicate that post-deployment separation rates are considerably higher among reservists symptomatic of PTSD. Moreover, these differences in separation rates grow over time. For example, among reservists ending deployment in 2003, the effect of being symptomatic of PTSD on permanent separation increases from 3.1 percentage points in year 1 to 6.8 percentage points in year 4. Relative to the baseline year 4 separation rate of 33 percent, this implies that reservists symptomatic of PTSD are 21 percent more likely to separate within four years of deployment than reservists who are not symptomatic of PTSD. We observe similar trends in military separation rates for reservists ending deployments in 2004 and 2005.

Similar patterns are apparent when we consider the number of reported days of active-duty service over the year, a more continuous measure of military participation. As Table 6.2 demonstrates, in the first year after the end of deployment, reservists symptomatic of PTSD actually have more active-duty days than those who are not symptomatic of PTSD. Given that separation rates are also higher for this population, those who choose to remain in the military must have more active-duty days than their counterparts in the first year following deployment. This pattern of results helps explain the positive effect of being symptomatic of PTSD on military earnings in the first year following deployment. However, in the second year following deployment, reservists symptomatic of PTSD have fewer active-duty days than those in the control group, and this difference grows over time. The estimated effect of being symptomatic of PTSD on active-duty days, -11.9 days in year 4, is a 23 percent decrease. The basic patterns we observe in the bottom panel of Table 6.2 are also apparent in unreported regressions conditioned on having positive numbers of active-duty days in the post-deployment years, meaning that even among those who remain in the military, active-duty days of those who are symptomatic of PTSD decline relative to those who are not.

Although the data clearly indicate that reservists symptomatic of PTSD at the end of deployment leave the military at higher rates than other deployed reservists, precisely why this happens is unclear. One possibility is that individuals begin with similar tastes for military service but that traumatic experiences while deployed engender negative perceptions of military

Table 6.2
Effects of Being Symptomatic of PTSD on Measures of Military Persistence

Item Affected	First-Differenced OLS Regression Estimates			
	Deployment Ended in 2003–2006	Deployment Ended in 2003–2005	Deployment Ended in 2003–2004	Deployment Ended in 2003
Indicator for permanent military separation				
Post-deployment year 1	0.014** (0.002)	0.014** (0.003)	0.021** (0.004)	0.031** (0.008)
Post-deployment year 2		0.031** (0.003)	0.037** (0.005)	0.067** (0.01)
Post-deployment year 3			0.047** (0.005)	0.07** (0.01)
Post-deployment year 4				0.068** (0.01)
N	327,717	264,791	142,081	51,149
Number of days of active duty				
Post-deployment year 1	3.42** (0.77)	3.31** (0.86)	6.72** (1.33)	9.37** (2.99)
Post-deployment year 2		–3.46** (0.85)	–2.66* (1.27)	–7.01* (2.88)
Post-deployment year 3			–5.55** (1.26)	–12.39** (2.71)
Post-deployment year 4				–11.91** (2.7)
N	321,919	260,261	139,812	50,399

NOTES: These regressions are analogous to those in Table 6.1, but they consider outcomes other than earnings. Each table entry is a result of a unique regression, and each column examines a particular sample of reservists based on deployment end date. The top panel uses as outcomes indicators for whether an individual had permanently separated from the military as of the end of the *n*th calendar year following the end of deployment. The means of these indicators are 0.139 (year 1), 0.228 (year 2), 0.295 (year 3), and 0.327 (year 4). The bottom panel shows the number of days of active-duty service, and the days of active-duty service in the pre-deployment year are used as the pre-treatment observation when first-differencing. The mean number of days of active-duty service in the pre-deployment year was 67.2, and in the post-deployment years, it was 57.5 (year 1), 56.2 (year 2), 54.7 (year 3), and 52.3 (year 4). Heteroskedasticity-robust standard errors are reported in parentheses.

* denotes statistical significance at the 5-percent level, and ** denotes significance at the 1-percent level.

service in general and perhaps fear of being deployed in the future. This seems like a particularly relevant possibility, since continuing to serve in the military might exacerbate PTSD symptoms for some individuals by exposing them to circumstances that remind them of prior traumatic events. Alternatively, being symptomatic of PTSD may make reservists less productive in their military careers or may carry a stigma that compromises their ability to advance.

Conclusions

This report presents the first population-based estimates of the effect of being symptomatic of PTSD on earnings and employment among U.S. reservists completing deployment since September 11, 2001. These estimates indicate that reservists symptomatic of PTSD immediately following deployment earn 5 percent less than reservists without such symptoms, after accounting for demographic differences across the two groups. However, this correlation diminishes when we estimate first-differenced and IV models, which are likely to provide superior controls for endogeneity and unobserved heterogeneity. First-differenced models imply that being symptomatic of PTSD lowers the earnings of reservists in the first year following deployment by about 1 to 2 percent, while IV models imply effects of about 4 percent. Effects of being symptomatic of PTSD on underemployment are larger, suggesting that the impact of PTSD might be more substantial for those in the lower tails of the earnings distribution.

Although some reservists doubtless experience substantial problems in the labor market stemming from combat-related psychological trauma, our analysis indicates that the average short-run effects of being symptomatic of PTSD are relatively small. Over time, however, the effects on earnings increase, growing to about 6 percent of total earnings by the fourth year following deployment in our first-differenced model. These longer-term negative effects are attributable entirely to higher military separation rates among those symptomatic of PTSD, a concomitant decline in military earnings, and no compensating increase in civilian labor market earnings.

Our analysis highlights several issues for further research. Although a growing body of research seeks to understand the impacts of combat-related mental health problems on the social, behavioral, and economic outcomes of veterans, many studies do so without the aid of longitudinal data or significant information about factors that may predict susceptibility to mental illness. Our data demonstrate that symptoms of PTSD occur nonrandomly, underscoring the necessity of carefully isolating the effects of mental health problems from other factors that may contribute to adverse labor market and other outcomes. Additionally, although we are able to move beyond existing research in demonstrating how the effects of being symptomatic of PTSD vary over time, our analysis is limited in that we measure PTSD symptoms for a given reservist at a single point in time, do not have access to formal diagnostic information regarding PTSD, and have no information about whether reservists received treatment for PTSD. Given the large number of veterans exposed to traumatic events in Iraq and Afghanistan, further research to better understand the time course of PTSD and its impacts is warranted.

Appendix A
Post-Deployment Health Assessment



POST-DEPLOYMENT

Health Assessment

33348

Authority: 10 U.S.C. 136 Chapter 55. 1074f, 3013, 5013, 8013 and E.O. 9397

Principal Purpose: To assess your state of health after deployment outside the United States in support of military operations and to assist military healthcare providers in identifying and providing present and future medical care to you.

Routine Use: To other Federal and State agencies and civilian healthcare providers, as necessary, in order to provide necessary medical care and treatment.

Disclosure: (Military personnel and DoD civilian Employees Only) Voluntary. If not provided, healthcare WILL BE furnished, but comprehensive care may not be possible.

INSTRUCTIONS: Please read each question completely and carefully before marking your selections. Provide a response for each question. If you do not understand a question, ask the administrator.

Demographics

Last Name

First Name

MI

Name of Your Unit or Ship during this Deployment

Gender

- ☐ Male
☐ Female

Service Branch

- ☐ Air Force
☐ Army
☐ Coast Guard
☐ Marine Corps
☐ Navy
☐ Other

Component

- ☐ Active Duty
☐ National Guard
☐ Reserves
☐ Civilian Government Employee

Location of Operation

- ☐ Europe
☐ SW Asia
☐ SE Asia
☐ Asia (Other)
- ☐ Australia
☐ Africa
☐ Central America
☐ Unknown

- ☐ South America
☐ North America
☐ Other

To what areas were you mainly deployed:
(mark all that apply - list where/date arrived)

- ☐ Kuwait
☐ Qatar
☐ Afghanistan
☐ Bosnia
☐ On a ship

- ☐ Iraq
☐ Turkey
☐ Uzbekistan
☐ Kosovo
☐ CONUS
☐ Other

Today's Date (dd/mm/yyyy)

Social Security Number

DOB (dd/mm/yyyy)

Date of arrival in theater (dd/mm/yyyy)

Date of departure from theater (dd/mm/yyyy)

Pay Grade

- ☐ E1
☐ E2
☐ E3
☐ E4
☐ E5
☐ E6
☐ E7
☐ E8
☐ E9
- ☐ 001
☐ 002
☐ 003
☐ 004
☐ 005
☐ 006
☐ 007
☐ 008
☐ 009
☐ 010
- ☐ W1
☐ W2
☐ W3
☐ W4
☐ W5
☐ Other

Name of Operation:

Occupational specialty during this deployment
(MOS, NEC or AFSC)

Combat specialty:

Administrator Use Only

Indicate the status of each of the following:

Yes No N/A

- ☐ ☐ ☐ Medical threat debriefing completed
☐ ☐ ☐ Medical information sheet distributed
☐ ☐ ☐ Post Deployment serum specimen collected

33348



Please answer all questions in relation to THIS deployment

1. Did your health change during this deployment?

- ☐ Health stayed about the same or got better
☐ Health got worse

2. How many times were you seen in sick call during this deployment?

--	--

No. of times

3. Did you have to spend one or more nights in a hospital as a patient during this deployment?

- ☐ No
☐ Yes, reason/dates: _____

4. Did you receive any vaccinations just before or during this deployment?

- ☐ Smallpox (leaves a scar on the arm)
☐ Anthrax
☐ Botulism
☐ Typhoid
☐ Meningococcal
☐ Other, list: _____
☐ Don't know
☐ None

5. Did you take any of the following medications during this deployment?

(mark all that apply)

- ☐ PB (pyridostigmine bromide) nerve agent pill
☐ Mark-1 antidote kit
☐ Anti-malaria pills
☐ Pills to stay awake, such as dexedrine
☐ Other, please list: _____
☐ Don't know

6. Do you have any of these symptoms now or did you develop them anytime during this deployment?

No	Yes	During	Yes	Now	No	Yes	During	Yes	Now
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Chronic cough	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Chest pain or pressure
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Runny nose	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Dizziness, fainting, light headedness
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Fever	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Difficulty breathing
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Weakness	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Still feeling tired after sleeping
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Headaches	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Difficulty remembering
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Swollen, stiff or painful joints	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Diarrhea
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Back pain	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Frequent indigestion
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Muscle aches	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Vomiting
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Numbness or tingling in hands or feet	<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	ringing of the ears
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Skin diseases or rashes					
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Redness of eyes with tearing					
<input type="radio"/>	<input type="radio"/>		<input type="radio"/>	Dimming of vision, like the lights were going out					

7. Did you see anyone wounded, killed or dead during this deployment?

(mark all that apply)

- ☐ No ☐ Yes - coalition ☐ Yes - enemy ☐ Yes - civilian

10. Are you currently interested in receiving help for a stress, emotional, alcohol or family problem?

- ☐ No ☐ Yes

8. Were you engaged in direct combat where you discharged your weapon?

- ☐ No ☐ Yes (☐ land ☐ sea ☐ air)

9. During this deployment, did you ever feel that you were in great danger of being killed?

- ☐ No ☐ Yes

11. Over the LAST 2 WEEKS, how often have you been bothered by any of the following problems?

None	Some	A Lot	
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Little interest or pleasure in doing things
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Feeling down, depressed, or hopeless
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>	Thoughts that you would be better off dead or hurting yourself in some way

36 Post-Traumatic Stress Disorder and the Earnings of Military Reservists

12. Have you ever had any experience that was so frightening, horrible, or upsetting that, IN THE PAST MONTH, you

No Yes

- ☐ ☐ Have had any nightmares about it or thought about it when you did not want to?
- ☐ ☐ Tried hard not to think about it or went out of your way to avoid situations that remind you of it?
- ☐ ☐ Were constantly on guard, watchful, or easily startled?
- ☐ ☐ Felt numb or detached from others, activities, or your surroundings?

13. Are you having thoughts or concerns that ...

No Yes Unsure

- ☐ ☐ ☐ You may have serious conflicts with your spouse, family members, or close friends?
- ☐ ☐ ☐ You might hurt or lose control with someone?

14. While you were deployed, were you exposed to:
(mark all that apply)

No Sometimes Often

- | | | | |
|-----------------------|-----------------------|-----------------------|--|
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | DEET insect repellent applied to skin |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Pesticide-treated uniforms |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Environmental pesticides (like area fogging) |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Flea or tick collars |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Pesticide strips |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Smoke from oil fire |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Smoke from burning trash or feces |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Vehicle or truck exhaust fumes |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Tent heater smoke |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | JP8 or other fuels |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Fog oils (smoke screen) |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Solvents |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Paints |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Ionizing radiation |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Radar/microwaves |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Lasers |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Loud noises |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Excessive vibration |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Industrial pollution |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Sand/dust |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Depleted Uranium (If yes, explain) _____ |
| <input type="radio"/> | <input type="radio"/> | <input type="radio"/> | Other exposures _____ |

15. On how many days did you wear your MOPP over garments?

--	--

No. of days

16. How many times did you put on your gas mask because of alerts and NOT because of exercises?

--	--

No. of times

17. Were you in or did you enter or closely inspect any destroyed military vehicles?

☐ No ☐ Yes

18. Do you think you were exposed to any chemical, biological, or radiological warfare agents during this deployment?

☐ No ☐ Don't know
☐ Yes, explain with date and location

Health Care Provider Only

SERVICE MEMBER'S SOCIAL SECURITY #

				—			—				
--	--	--	--	---	--	--	---	--	--	--	--

Post-Deployment Health Care Provider Review, Interview, and Assessment

Interview

1. Would you say your health in general is: ☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor
2. Do you have any medical or dental problems that developed during this deployment? ☐ Yes ☐ No
3. Are you currently on a profile or light duty? ☐ Yes ☐ No
4. During this deployment have you sought, or do you now intend to seek, counseling or care for your mental health? ☐ Yes ☐ No
5. Do you have concerns about possible exposures or events during this deployment that you feel may affect your health? ☐ Yes ☐ No
Please list concerns: _____
6. Do you currently have any questions or concerns about your health? ☐ Yes ☐ No
Please list concerns: _____

Health Assessment

After my interview/exam of the service member and review of this form, there is a need for further evaluation as indicated below than one may be noted for patients with multiple problems. Further documentation of the problem evaluation to be placed in the member's medical record.) w. (More service

REFERRAL INDICATED FOR:

- ☐ None
- ☐ Cardiac
- ☐ Combat/Operational Stress Reaction
- ☐ Dental
- ☐ Dermatologic
- ☐ ENT
- ☐ Eye
- ☐ Family Problems
- ☐ Fatigue, Malaise, Multisystem complaint
- ☐ Audiology

- ☐ GI
- ☐ GU
- ☐ GYN
- ☐ Mental Health
- ☐ Neurologic
- ☐ Orthopedic
- ☐ Pregnancy
- ☐ Pulmonary
- ☐ Other _____

EXPOSURE CONCERNS (During deployment):

- ☐ Environmental
- ☐ Occupational
- ☐ Combat or mission related
- ☐ None

Comments: _____

I certify that this review process has been completed.
Provider's signature and stamp:

--

This visit is coded by V70.5 __ 6

Date (dd/mm/yyyy)

				/				/				
--	--	--	--	---	--	--	--	---	--	--	--	--

End of Health Review

DD FORM 2796, APR 2003

ASD(HA) APPROVED



Appendix B

Pre-Deployment Health Assessment



33823

PRE-DEPLOYMENT Health Assessment

Authority: 10 U.S.C. 136 Chapter 55, 1074f, 3013, 5013, 8013 and E.O. 9397

Principal Purpose: To assess your state of health before possible deployment outside the United States in support of military operations and to assist military healthcare providers in identifying and providing present and future medical care to you.

Routine Use: To other Federal and State agencies and civilian healthcare providers, as necessary, in order to provide necessary medical care and treatment.

Disclosure: **(Military personnel and DoD civilian Employees Only)** Voluntary. If not provided, healthcare WILL BE furnished, but comprehensive care may not be possible.

INSTRUCTIONS: Please read each question completely and carefully before marking your selections. Provide a response for each question. If you do not understand a question, ask the administrator.

Demographics

Last Name		Today's Date (dd/mm/yyyy)	
<input type="text"/>		<input type="text"/>	
First Name	MI	Social Security Number	
<input type="text"/>	<input type="text"/>	<input type="text"/>	
Deploying Unit		DOB (dd/mm/yyyy)	
<input type="text"/>		<input type="text"/>	

Gender	Service Branch	Component	Pay Grade
<input type="radio"/> Male <input type="radio"/> Female	<input type="radio"/> Air Force <input type="radio"/> Army <input type="radio"/> Coast Guard <input type="radio"/> Marine Corps <input type="radio"/> Navy <input type="radio"/> Other	<input type="radio"/> Active Duty <input type="radio"/> National Guard <input type="radio"/> Reserves <input type="radio"/> Civilian Government Employee	<input type="radio"/> E1 <input type="radio"/> O1 <input type="radio"/> W1 <input type="radio"/> E2 <input type="radio"/> O2 <input type="radio"/> W2 <input type="radio"/> E3 <input type="radio"/> O3 <input type="radio"/> W3 <input type="radio"/> E4 <input type="radio"/> O4 <input type="radio"/> W4 <input type="radio"/> E5 <input type="radio"/> O5 <input type="radio"/> W5 <input type="radio"/> E6 <input type="radio"/> O6 <input type="radio"/> Other <input type="radio"/> E7 <input type="radio"/> O7 <input type="radio"/> E8 <input type="radio"/> O8 <input type="radio"/> E9 <input type="radio"/> O9 <input type="radio"/> <input type="radio"/> O10

Location of Operation

- | | |
|-------------------------------------|---------------------------------------|
| <input type="radio"/> Europe | <input type="radio"/> Australia |
| <input type="radio"/> SW Asia | <input type="radio"/> Africa |
| <input type="radio"/> SE Asia | <input type="radio"/> Central America |
| <input type="radio"/> Asia (Other) | <input type="radio"/> Unknown |
| <input type="radio"/> South America | |

Deployment Location (IF KNOWN) (CITY, TOWN, or BASE):

List country (IF KNOWN):

Name of Operation:

Administrator Use Only

Indicate the status of each of the following:

Yes	No	N/A
<input type="radio"/>	<input type="radio"/>	<input type="radio"/> Medical threat briefing completed
<input type="radio"/>	<input type="radio"/>	<input type="radio"/> Medical information sheet distributed
<input type="radio"/>	<input type="radio"/>	<input type="radio"/> Serum for HIV drawn within 12 months
<input type="radio"/>	<input type="radio"/>	<input type="radio"/> Immunizations current
<input type="radio"/>	<input type="radio"/>	<input type="radio"/> PPD screening within 24 months

33823





33823

PLEASE FILL IN SOCIAL SECURITY #

				-			-				
--	--	--	--	---	--	--	---	--	--	--	--

Health Assessment

1. Would you say your health in general is: ☐ Excellent ☐ Very Good ☐ Good ☐ Fair ☐ Poor
2. Do you have any medical or dental problems? ☐ Yes ☐ No
3. Are you currently on a profile, or light duty, or are you undergoing a medical board? ☐ Yes ☐ No
4. Are you pregnant? (FEMALES ONLY) ☐ Don't Know ☐ Yes ☐ No
5. Do you have a 90-day supply of your prescription medication or birth control pills? ☐ N/A ☐ Yes ☐ No
6. Do you have two pairs of prescription glasses (if worn) and any other personal medical equipment? ☐ N/A ☐ Yes ☐ No
7. During the past year, have you sought counseling or care for your mental health? ☐ Yes ☐ No
8. Do you currently have any questions or concerns about your health? ☐ Yes ☐ No

Please list your concerns:

Service Member Signature

I certify that responses on this form are true.

Pre-Deployment Health Provider Review (For Health Provider Use Only)

After interview/exam of patient, the following problems were noted and categorized by Review of Systems. More than one may be noted for patients with multiple problems. Further documentation of problem to be placed in medical records.

REFERRAL INDICATED

- ☐ None
- ☐ Cardiac
- ☐ Combat / Operational Stress Reaction
- ☐ Dental
- ☐ Dermatologic
- ☐ ENT
- ☐ Eye
- ☐ Family Problems
- ☐ Fatigue, Malaise, Multisystem complaint

- ☐ GI
- ☐ GU
- ☐ GYN
- ☐ Mental Health
- ☐ Neurologic
- ☐ Orthopedic
- ☐ Pregnancy
- ☐ Pulmonary
- ☐ Other _____

FINAL MEDICAL DISPOSITION:

Comments: (If not deployable, explain)

- ☐ Deployable ☐ Not Deployable

I certify that this review process has been completed.

Provider's signature and stamp:

Date (dd/mm/yyyy)

		/			/				
--	--	---	--	--	---	--	--	--	--

End of Health Review

33823



Bibliography

- Alexandre, P. K., and M. T. French, "Labor Supply of Poor Residents in Metropolitan Miami, Florida: The Role of Depression and the Co-Morbid Effects of Substance Use," *The Journal of Mental Health Policy and Economics*, Vol. 4, 2001, pp. 161–173.
- Anderson, K. H., and J. M. Mitchell, "Effects of Military Experience on Mental Health Problems and Work Behavior," *Medical Care*, Vol. 30, No. 6, 1992, pp. 554–563.
- Berndt, E. R., S. N. Finkelstein, P. E. Greenberg, R. H. Howland, A. Keith, A. J. Rush, J. Russell, and M. B. Keller, "Workplace Performance Effects from Chronic Depression and Its Treatment," *Journal of Health Economics*, Vol. 17, 1998, pp. 511–535.
- Bliese P., K. Wright, A. Adler, O. Cabrera, C. Castro, and C. Hoge, "Validating the Primary Care Posttraumatic Stress Disorder Screen and the Posttraumatic Stress Disorder Checklist with Soldiers Returning from Combat," *Journal of Consulting and Clinical Psychology*, Vol. 76, No. 2, 2008, pp. 272–281.
- Bliese, P., K. Wright, A. Adler, and J. Thomas, *Validation of the 90 to 120 Day Post-Deployment Psychological Short Screen*, U.S. Army Medical Research Unit-Europe, USAMRU-E Research Report 2004-02, 2004.
- Bremner, J. D., S. M. Southwick, A. Darnell, and D. S. Charney, "Chronic PTSD in Vietnam Combat Veterans: Course of Illness and Substance Abuse," *American Journal of Psychiatry*, Vol. 153, No. 3, 1996, pp. 369–375.
- Breslau, N., G. C. Davis, and P. Andreski, "Risk Factors for PTSD-Related Traumatic Events: A Prospective Analysis," *American Journal of Psychiatry*, Vol. 152, No. 4, 1995, pp. 529–535.
- Byrne, C. A., and D. S. Riggs, "The Cycle of Trauma: Relationship Aggression in Male Vietnam Veterans with Symptoms of Posttraumatic Stress Disorder," *Violence and Victims*, Vol. 11, No. 3, 1996, pp. 213–225.
- Cesur, Resul, Joseph Sabia, and Tekin Erdal, *The Psychological Costs of War: Military Combat and Mental Health*, Cambridge, Mass.: National Bureau of Economic Research, NBER Working Paper 16927, 2011.
- Chatterji, P., M. Alegria, M. Lu, and D. Takeuchi, "Psychiatric Disorders and Labor Market Outcomes: Evidence from the National Latino and Asian American Study," *Health Economics*, Vol. 16, 2007, pp. 1069–1090.
- Chatterji, P., M. Alegria, and D. Takeuchi, *Psychiatric Disorders and Employment: New Evidence from the Collaborative Psychiatric Epidemiology Surveys*, Cambridge, Mass.: National Bureau of Economic Research, NBER Working Paper 14404, 2008.
- Congressional Research Service, "National Guard Personnel and Deployments: Fact Sheet," CRS Report to Congress (RS22451), Washington, D.C.: Library of Congress, 2008.
- CRS—See Congressional Research Service.
- Cseh, A., "The Effects of Depressive Symptoms on Earnings," *Southern Economic Journal*, Vol. 75, No. 2, 2008, pp. 383–409.
- DoD—See Department of Defense.
- Department of Defense, "Updated Procedures for Deployment Health Surveillance and Readiness," MCM-0006-02, February 1, 2002.
- Ettner, S. L., R. G. Frank, and R. C. Kessler, "The Impact of Psychiatric Disorders on Labor Market Outcomes," *Industrial and Labor Relations Review*, Vol. 51, 1997, pp. 64–81.

- Hamilton, V. H., P. Merrigan, et al., "Down and Out: Estimating the Relationship Between Mental Health and Unemployment," *Health Economics*, Vol. 6, 1997, pp. 397–406.
- Hausman, J. A., J. Abrevaya, and F. M. Scott-Morton, "Misclassification of the Dependent Variable in a Discrete-Response Setting," *Journal of Econometrics*, Vol. 87, 1998, pp. 239–269.
- Hoge, C. W., J. L. Auchterlonie, and C. S. Milliken, "Mental Health Problems, Use of Mental Health Services, and Attrition from Military Service After Returning from Deployment to Iraq or Afghanistan," *Journal of the American Medical Association*, Vol. 295, No. 9, 2006, pp. 1023–1032.
- Hoge, C. W., C. A. Castro, S. C. Messer, D. McGurk, et al., "Combat Duty in Iraq and Afghanistan, Mental Health Problems, and Barriers to Care," *New England Journal of Medicine*, Vol. 351, No. 1, 2004, pp. 13–22.
- Imbens, G. W., and J. D. Angrist, "Identification and Estimation of Local Average Treatment Effects," *Econometrica*, Vol. 62, No. 2, 1994, pp. 467–475.
- Iversen, A., V. Nikolaou, N. Greenberg, C. Unwin, L. Hull, M. Hotopf, C. Dandeker, J. Ross, and S. Wessely, "What Happens to British Veterans When They Leave the Armed Forces?" *European Journal of Public Health*, Vol. 15, No. 2, 2005, pp. 175–184.
- Jordan, B. K., C. R. Marmar, J. A. Fairbank, W. E. Schlenger, R. A. Kulka, R. L. Hough, and D. S. Weiss, "Problems in Families of Male Vietnam Veterans with Posttraumatic Stress Disorder," *Journal of Consulting and Clinical Psychology*, Vol. 60, No. 6, 1992, pp. 916–926.
- Kessler, R. C., C. Barber, H. G. Birnbaum, R. G. Frank, P. E. Greenberg, R. M. Rose, G. E. Simon, and P. Wang, "Depression in the Workplace: Effects on Short-Term Disability," *Health Affairs*, Vol. 5, 1999, pp. 163–171.
- King, D. W., L. A. King, D. W. Foy, and D. M. Gudanowski, "Prewar Factors in Combat-Related Posttraumatic Stress Disorder: Structural Equation Modeling with a National Sample of Female and Male Vietnam Veterans," *Journal of Consulting and Clinical Psychology*, Vol. 64, No. 3, 1996, pp. 520–531.
- Lasko, N. B., T. V. Gurvits, A. A. Kuhne, S. P. Orr, and R. K. Pitman, "Aggression and Its Correlates in Vietnam Veterans With and Without Chronic Posttraumatic Stress Disorder," *Comprehensive Psychiatry*, Vol. 35, No. 5, 1994, pp. 373–381.
- Lauterbach, D., and S. Vrana, "The Relationship Among Personality Variables, Exposure to Traumatic Events, and Severity of Posttraumatic Stress Symptoms," *Journal of Traumatic Stress*, Vol. 14, No. 1, 2001, pp. 29–45.
- Lyle, David S., "Using Military Deployments and Job Assignments to Estimate the Effect of Parental Absences and Household Relocations on Children's Academic Achievement," *Journal of Labor Economics*, Vol. 24, No. 2, 2006, pp. 319–350.
- McCarren, M., G. R. Janes, J. Goldberg, S. A. Eisen, W. R. True, and W. G. Henderson, "A Twin Study of the Association of Post-Traumatic Stress Disorder and Combat Exposure with Long-Term Socioeconomic Status in Vietnam Veterans," *Journal of Traumatic Stress*, Vol. 8, No. 1, 1995, pp. 111–124.
- McFall, M. E., P. W. Mackay, and D. M. Donovan, "Combat-Related Posttraumatic Stress Disorder and Severity of Substance Abuse in Vietnam Veterans," *Journal of Studies on Alcohol*, Vol. 53, No. 4, 1992, pp. 357–363.
- McFarlane, A. C., "Posttraumatic Stress Disorder: A Model of the Longitudinal Course and the Role of Risk Factors," *Journal of Clinical Psychiatry*, Vol. 61 (suppl. 5), 2000, pp. 15–20.
- Milliken, C. S., J. L. Auchterlonie, and C. W. Hoge, "Longitudinal Assessment of Mental Health Problems Among Active and Reserve Component Soldiers Returning from the Iraq War," *Journal of the American Medical Association*, Vol. 298, No. 18, 2007, pp. 2141–2148.
- Neal, D., and W. Johnson, "The Role of Premarket Factors in Black-White Wage Differences," *Journal of Political Economy*, Vol. 104, No. 5, 1996, pp. 869–895.
- Ojeda, V. D., R. G. Frank, T. G. McGuire, and T. P. Gilmer, "Mental Illness, Nativity, Gender, and Labor Supply," *Health Economics*, Vol. 19, 2010, pp. 396–421.
- Prins, A., P. Ouimette, R. Kimerling, R. P. Camerond, D. S. Hugelshofer, J. Shaw-Hegwer, A. Thrailkill, F. D. Gusman, and J. I. Sheikh, "The Primary Care PTSD Screen (PC-PTSD): Development and Operating Characteristics," *Primary Care Psychiatry*, Vol. 9, No. 1, 2004, pp. 9–14.

- Richardson, R. D., C. C. Engel, S. C. Hunt, K. McKnight, and M. McFall, "Are Veterans Seeking Veterans Affairs' Primary Care as Healthy as Those Seeking Department of Defense Primary Care? A Look at Gulf War Veterans' Symptoms and Functional Status," *Psychosomatic Medicine*, Vol. 64, 2002, pp. 676–683.
- Riggs, D. S., C. A. Byrne, F. W. Weathers, and B. T. Litz, "The Quality of the Intimate Relationships of Male Vietnam Veterans: Problems Associated with Posttraumatic Stress Disorder," *Journal of Traumatic Stress*, Vol. 11, No. 1, 1998, pp. 87–101.
- Roberts, W. R., W. E. Penk, R. Robinowitz, M. P. Dolan, M. L. Gearing, and E. L. Patterson, "Interpersonal Problems of Vietnam Combat Veterans with Symptoms of Posttraumatic Stress Disorder," *Journal of Abnormal Psychology*, Vol. 91, No. 6, 1982, pp. 444–450.
- Savoca, E., and Rosenheck, R., "The Civilian Labor Market Experiences of Vietnam-Era Veterans: The Influence of Psychiatric Disorders," *Journal of Mental Health Policy and Economics*, Vol. 3, 2000, pp. 199–207.
- Schnurr, P. P., C. A. Lunney, and A. Sengupta, "Risk Factors for the Development Versus Maintenance of Posttraumatic Stress Disorder," *Journal of Traumatic Stress*, Vol. 17, No. 2, 2004, pp. 85–95.
- Seal, K., T. J. Metzler, K. S. Gima, D. Bertenthal, S. Maguen, and C. R. Marmar, "Trends and Risk Factors for Mental Health Diagnoses Among Iraq and Afghanistan Veterans Using Department of Veterans Affairs Health Care, 2002–2008," *American Journal of Public Health*, Vol. 99, 2009, pp. 1651–1658.
- Shea, M. T., A. A. Vujanovic, A. K. Mansfield, E. Sevin, and F. Liu, "Posttraumatic Stress Disorder Symptoms and Functional Impairment Among OEF and OIF National Guard and Reserve Veterans," *Journal of Traumatic Stress*, Vol. 23, No. 1, 2010, pp. 100–107.
- Shen, Y., J. Arkes, B. Kwan, L. Tan, and T. Williams, *The Effect Of OEF/OIF Deployment Intensity on the Rate of Posttraumatic Stress Disorder Among Active Duty Population*, Cambridge, Mass.: National Bureau of Economic Research, NBER Working Paper 15203, 2009.
- Smith, M. W., P. P. Schnurr, and R. A. Rosenheck, "Employment Outcomes and PTSD Symptom Severity," *Mental Health Services Research*, Vol. 7, No. 2, 2005, pp. 89–101.
- Taft, C. T., D. S. Vogt, A. D. Marshall, J. Panuzio, and B. L. Niles, "Aggression Among Combat Veterans: Relationships with Combat Exposure and Symptoms of Posttraumatic Stress Disorder, Dysphoria, and Anxiety," *Journal of Traumatic Stress*, Vol. 20, No. 2, 2007, pp. 135–145.
- Tanielian, T., and L. H. Jaycox, eds., *Invisible Wounds of War: Psychological and Cognitive Injuries, Their Consequences, and Services to Assist Recovery*, Santa Monica, Calif.: RAND Corporation, MG-720-CCF, 2008. As of June 8, 2011:
<http://www.rand.org/pubs/monographs/MG720.html>
- White, H., "Maximum Likelihood Estimation of Misspecified Models," *Econometrica*, Vol. 50, No. 1, 1982, pp. 1–25.
- Wooldridge, J. M., *Econometric Analysis of Cross Section and Panel Data*, Cambridge, Mass.: MIT Press, 2002.